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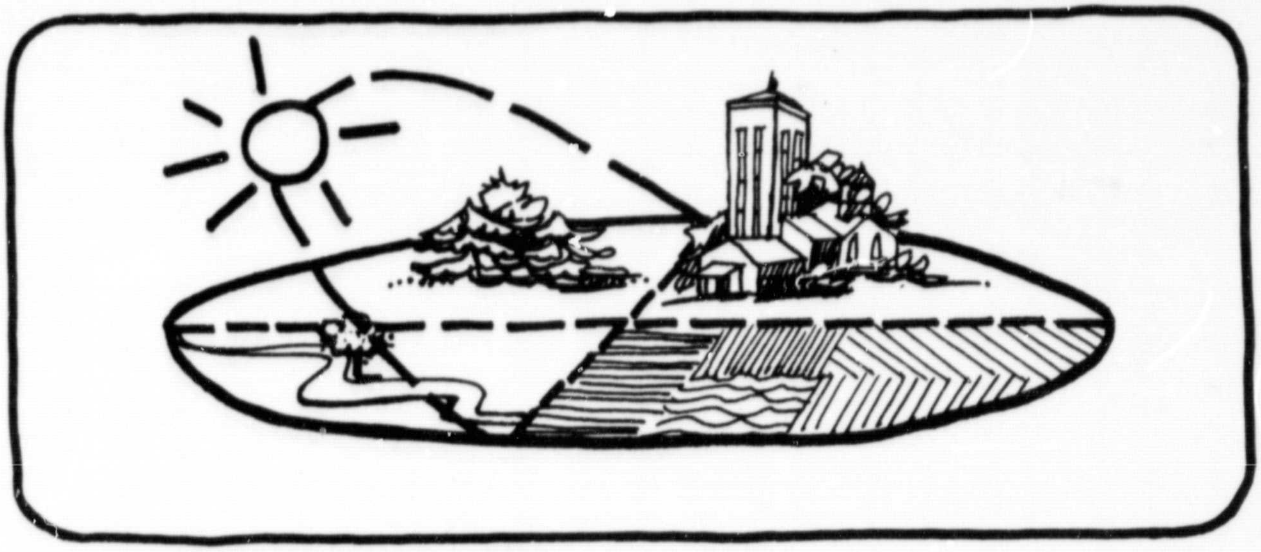
Land Availability and Land Value Assessment
for
Solar Ponds In The United States



for
California Institute of Technology
Jet Propulsion Laboratory
JPL Contract No. 955978

May 1982

The Benham Group

LAND AVAILABILITY AND LAND VALUE ASSESSMENT FOR SOLAR PONDS IN THE UNITED STATES

CALIFORNIA INSTITUTE OF TECHNOLOGY

JET PROPULSION LABORATORY

PASADENA, CALIFORNIA

JPL CONTRACT NO. 955978

May 1982

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TECHNICAL CONTENT STATEMENT

PREFACE

This report is designed to assess the land availability and land values for solar ponds in the United States. This report represents only one increment of the overall solar pond applicability studies performed by JPL. While the report in itself is complete and can stand alone, it is a preliminary planning study in which the overall intent is to provide JPL with a working document that will supplement their comprehensive ongoing studies concerning solar pond technology.

The basis of the analysis presented in this report involves the evaluation of 30 case study cities. These 30 cities were selected from a list of over 2,200. These cities have not been selected by JPL for specific application of solar pond technology but have been selected by The Benham Group to establish a data base and to assess land availability/land values on a regional basis. The results obtained from this study and some of the trends that are established could lead to the potential selection of any of these cities for further study, should JPL decide to proceed with more in-depth evaluations. On the other hand, future studies might involve an analysis of a completely different set of cities than those selected here. It should be emphasized there is no intent to indicate that any of the cities evaluated in this report will be receiving further attention regarding the application of solar pond technology. It is likely, should further studies be implemented, that investigations will take place on a district level in areas where solar pond development potential is high.

ABSTRACT

The purpose of this investigation is to assess the land availability and land values for solar ponds in the United States as they concern the residential, commercial, and institutional land-use categories. Solar ponds have been identified as efficient and economical means for collecting and storing direct and diffuse solar energy. Innovative methodologies have been applied to arrive at regional projections regarding the amount of land that might potentially be available for retrofit or future solar pond applications. Regional land values have also been documented and analyzed. Much of the data presented is based on general assumptions and can be perceived as theoretical, although the data base representing the case study cities is based on specific input from each of the cities.

In making regional projections, site-specific applications of the data are limited. In general, the study revealed that there is potentially more land available for solar pond applications east of the Mississippi River, but the best suited applications could be in the expanding and dynamic western part of the country. Land prices have been affected by this growth because the West reflects higher overall land values. Future in-depth, site-specific studies are recommended as a follow-up to this report and to the comprehensive solar pond applicability studies developed by the Jet Propulsion Laboratory.

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1.0 INTRODUCTION

1.1 PURPOSE

The objective of this project is to conduct a study that will determine, on a regional basis, the potential size and limits of the solar pond market in the residential, commercial, and institutional sectors in the United States and Puerto Rico. Included in this study is a general assessment of land availability and market-land values for specific regions defined by the Jet Propulsion Laboratory (JPL).

1.2 BACKGROUND -- SOLAR POND TECHNOLOGY

Nonconvecting solar ponds have attracted much attention recently as an efficient and economical means for collecting and storing direct and diffuse solar energy. In principle, a solar pond is a shallow, artificial or natural black-bottom pond or lake in which the incident solar radiation is converted and trapped as thermal energy in the bottom layer of the pond bottom. In salt-stratified ponds, a vertical density gradient is artificially created and maintained as such that the salt concentration and pond density increase with depth. In other words, although the bottom layer is the warmest, it has the highest density because of the high salinity. This, in turn, prevents any vertical convection due to the presence of a thermal gradient in the pond. Consequently, thermal conduction is the only mechanism of heat transport from the bottom to the top of the pond because there is no radiative heat loss from the pond's bottom since water is opaque to thermal radiation at temperatures of about 80 to 100 degrees C. Thus, in a solar pond, salt water is used both for collection and storage of thermal energy. Temperatures as high as 100 degrees C at the bottom have been reported in field solar ponds. Thus, as a collector, a solar pond converts intermittent solar radiation into a continuous source of thermal energy.

Unlike any other solar collection system, the principle of the salt-gradient solar pond is manifested by nature at different places in the world. Examples of natural solar ponds or lakes are abundant in nature. Medve

Lagoon in the Southern Carpathians found by Von Kalecinsky in 1902 is the earliest recorded discovery of a naturally occurring salt-stratified lake. Since then, a number of other lakes manifesting this process have been found in Chile, Venezuela, and parts of Europe.

Generally, an artificial field solar pond is about 1 to 4 meters deep and very large in area to cut down on the heat loss from the sides of the pond. Most of the heat loss in such a system is from the top surface. Soil at the bottom of the pond provides additional storage to the pond. The storage capacity of a solar pond depends upon its depth and can be very large. This is one of the most unique features of a solar pond as compared to other solar collector systems. Because of built-in storage capability, solar ponds can be designed to store energy in summer for winter heating use. A number of recent studies have shown that the cost of thermal energy from solar ponds, $2 to $8 per million British thermal units (Btu), is competitive with present-day systems. Such a system can very effectively be used for space heating and cooling, agricultural and industrial process heating, and desalination. Moreover, because of their storage, solar ponds are being developed for base-load and peak-load electric power generation in Israel and the United States. It has been shown that due to very large storage capacity, a solar pond system can supply a peak load of as much as six times its average power capability without any adverse effect on its performance.

In practice, as is evident from Figure 1.2-1, a salt-stratified sodium chloride pond is comprised of three distinct layers. The bottom layer, also called the storage layer, is a convecting layer because this layer is withdrawn for energy extraction. This layer is quite uniform both in temperature and density and is about 40 to 50 percent of the entire pond depth. The middle layer is the nonconvecting layer and provides thermal insulation to the bottom layer. The top layer that can range from about 0 to 20 percent of the total depth depending upon ambient conditions is called the surface layer. The top layer does not serve any useful purpose but is present due to water evaporation and wind-induced mixing at the surface.

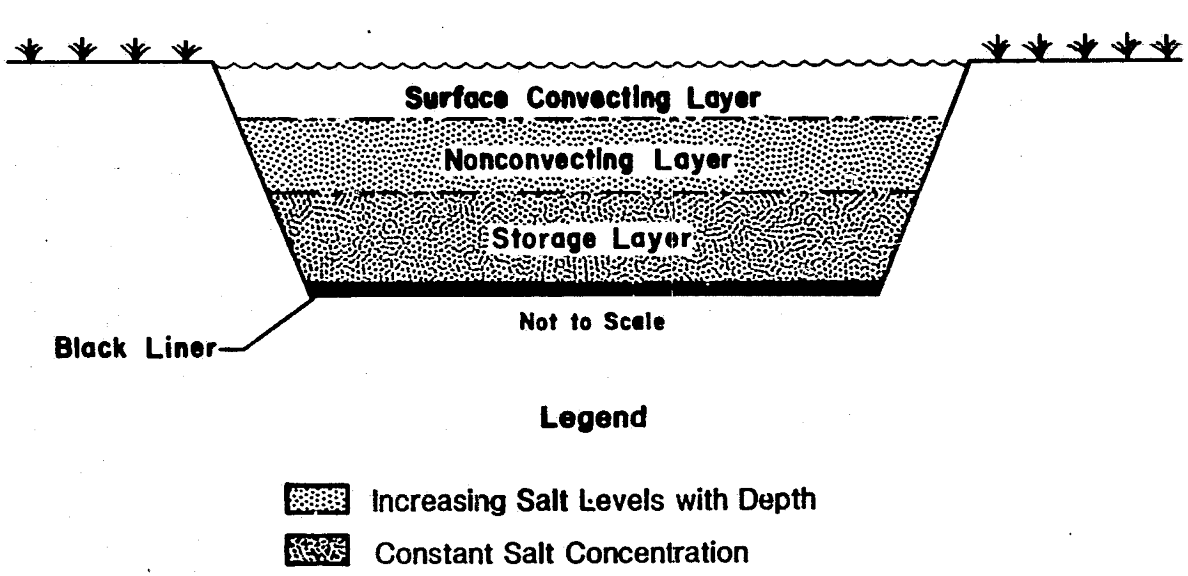

FIGURE 1.2-1

Schematic of a Salt-Stratified Sodium Chloride Pond

Figure 1.2-2 presents temperature profiles for a solar pond that is operating in Miamisburg, Ohio. Note the division of the layers as depicted by the temperature changes. The overall performance and collection efficiency of a solar pond system depends upon the amount of solar radiation reaching the bottom of the pond. Most of the long wave-length solar radiation, greater than 0.7 micron, is absorbed in the top few centimeters of the pond. Only about 30 percent of the incident radiation (primarily short wave-length) penetrates to about 1 to 2 meters of pond water provided it is transparent. Thus, it is very crucial to keep the pond optically very clean so that as much of the short wave-length radiation as ideally possible penetrates all the way to the pond's bottom for energy extraction. Overall, it can be said that the thermal collection efficiency of the pond decreases as the depth of the pond increases because less solar radiation penetrates the bottom. On the other hand, as the pond depth increases, the nonconvecting zone provides better insulation to the storage layer thereby reducing the heat loss from the bottom to the top of the pond. Thus, for every temperature desired at the bottom of the pond, there is an optimum pond depth. If pond depth is greater than the optimum, the fraction of solar insolation reaching the pond bottom is lower; if the pond depth is lower than the optimum depth, the heat loss from the pond is excessive.

Because of the salinity gradient, there is a natural diffusion of salt from the bottom to the top of the pond. However, in order to keep the pond stratified and therefore nonconvecting, it is necessary to counter this natural movement of salt caused by diffusion by external means. This is accomplished by supplying concentrated brine solution at the bottom of the salt layer and by flushing the top surface of the pond by "fresh" water. Limited experience with field solar ponds shows that because salt diffusion is a very slow process this can be accomplished by adjusting the pond salinity once every 6 to 12 months. More field experience in this area will be available in the coming years as operation and maintenance data are gathered from the present small-scale field solar ponds.

Solar ponds are more advantageous than other solar energy concepts in that they have the capacity to store large quantities of heat. Other alternative

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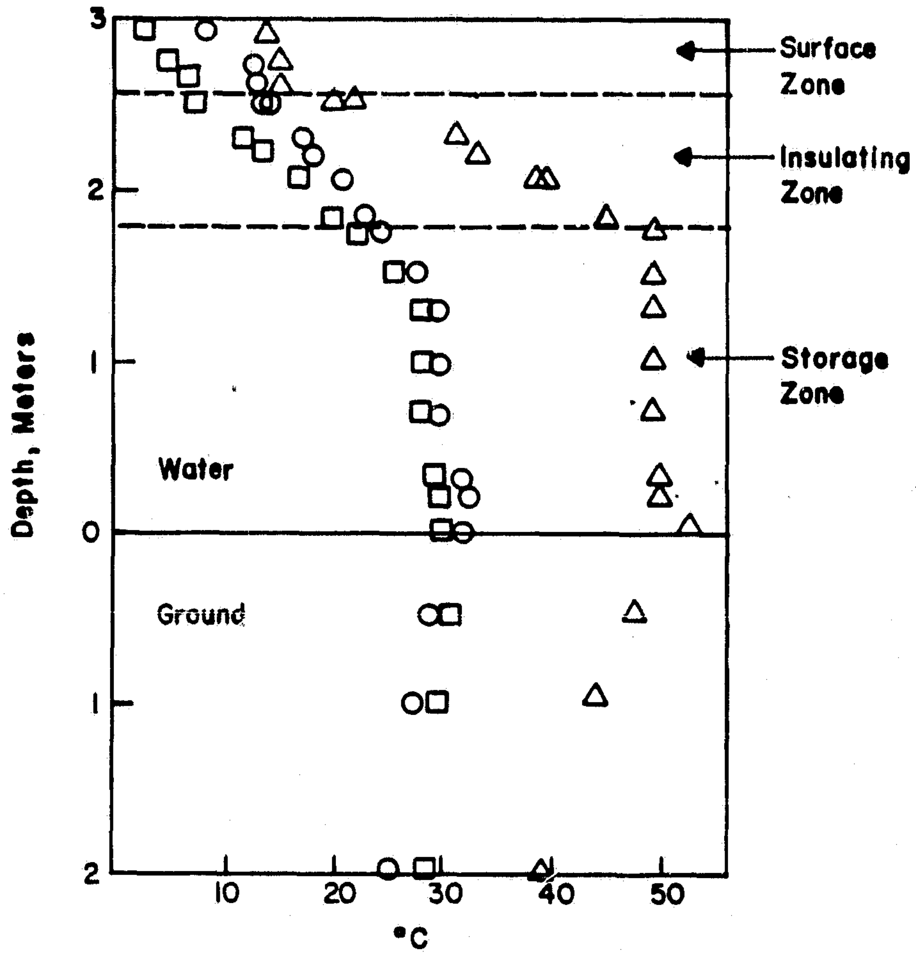

Legend

△ Temperature Data, 10/17/78

□ Temperature Data, 2/22/79

○ Temperature Data, 3/14/79

Source: Wittenberg and Harris 1979.

FIGURE 1.2-2

Temperature Profiles of a
Solar Pond in Miamisburg, Ohio

energy sources such as wind and hydro can only provide peak requirements when natural conditions are right (Business Week 1981).

The world's first commercial solar pond has been operating for over a year in Ein Bokek on the Dead Sea. Projects proposed for the United States include solar ponds at the Salton Sea in southern California, at the Great Salt Lake, on the Red River in Texas and Oklahoma, and on the Colorado River in Utah and southern California.

1.2.1 HEAT EXTRACTION

Two different schemes have been proposed to extract heat from the bottom of a solar pond system. In one scheme the brine from the bottom of a solar pond is withdrawn for circulation through an external heat exchanger. This approach is attractive for large installations and can result in higher heat-transfer rates in the heat exchanger. However, in order to make certain that the pond is not unduly disturbed and uniformly mixed, the brine withdrawal rate has to be lower than a critical value that depends on the pond stratification. In the other scheme, the heat exchanger is physically located at the bottom of the pond, and the working fluid to be heated is circulated through it. In this scheme there is no danger to the physical disturbance and mixing of the pond-salinity gradient; however, the heat-transfer coefficient is quite small because the bottom layer in which the heat exchanger is located is essentially a stagnant body of water.

1.2.2 SOLAR POND ECONOMICS

As mentioned before, a number of recent studies have shown that the cost of thermal energy from a salt-stratified solar pond is competitive with the present-day fossil fuel or other solar energy systems. By using an organic Rankine cycle system, a solar pond also can be used for electrical power generation both as a base-load and a peaking-load plant. For this application, the bottom layer of a solar pond acts as a heat source for the Rankine cycle system.

The overall economics of a solar pond collection system is very site dependent depending upon the cost of salt, liner, land, water, and the earthwork necessary to build a pond. The cost of salt generally represents a major portion of the total cost of a solar pond system. While it is true that the majority of field ponds have used sodium chloride, solar ponds in principle can really use any salt or salt mixture as long as such salts are sufficiently soluble in water to provide a solution density of about 1.15 grams per milliliter at 90 degrees C. Thus, naturally occurring minerals, seawater brine, and salt byproducts from different chemical processes can also be used as long as they can be procured at the desired site at a reasonable cost.

Following salt, the liner is the second most expensive item in a solar pond system. The liner is needed to eliminate the loss of salt and water to soil at the bottom of the pond. The liner material that is generally plastic must be able to withstand brine solutions up to about 100 degrees C without deterioration. For ponds built on salt flats, the liner may not be necessary because typically such soils are saturated with salt and impervious to brine leakage.

In order to initially fill the pond and to make up for evaporation losses from the surface, there must be a source of fresh water (rain or seawater, underground water, etc.) near the proposed solar pond site. Secondly, in order to maintain pond stratification, it is necessary to wash the top layer of the pond by fresh water so that its salinity does not increase significantly higher than the initial concentration. Depending upon the source of fresh water, the concentration of salt in the surface layer can be anywhere between 0 to 3.5 percent.

One other area that is important in the overall economics of a solar pond system is the land availability and land cost. This is particularly true if a solar pond is designed to provide thermal energy for a residential, institutional, or commercial building. This is true because for this application it is desirable to build a solar pond as close to the point of energy use as possible to cut down on the cost of energy transportation.

Whether sufficient suitable land at an acceptable price is available will depend upon each individual site location.

1.3 BACKGROUND -- ASSESSMENT OF MARKET POTENTIAL FOR SOLAR PONDS IN THE UNITED STATES

Benham-Blair & Affiliates, Inc., is under contract to JPL to assess land availability and land values for solar pond applications throughout the United States. This constitutes one portion of an overall "U.S. Solar Pond Regional Applicability Study" that is currently being developed by JPL in cooperation with the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA).

There are a number of factors that JPL must consider in evaluating the applicability of solar pond technology across the United States. Figure 1.3-1 summarizes the various factors that are being evaluated including technical, economic, environmental, institutional, and market sector considerations. Technical subfactors include an evaluation of land, water, salts, insolation, climate, geology, hydrology, design, performance, components, construction, operations, and maintenance. Economic factors to be assessed include pond/energy costs (model) and alternative energy costs. Market considerations include residential buildings, commercial and institutional buildings, industrial processes, agricultural processes, electricity, desalination, and ethanol production. Those factors being studied for this particular report are highlighted in Figure 1.3-1.

An important part of any study is to define and limit the area to be affected. In this case, the study area is the entire United States and Puerto Rico, but in order to better manage the evaluation process, JPL has divided the United States and Puerto Rico into 12 regions. Four natural resources are vital to the development of solar ponds -- sunshine, land, water, and salts. In defining the regions, JPL utilized the following criteria:

1. Defined regions should have several unifying characteristics within the region. Too few regions will eliminate significant details,

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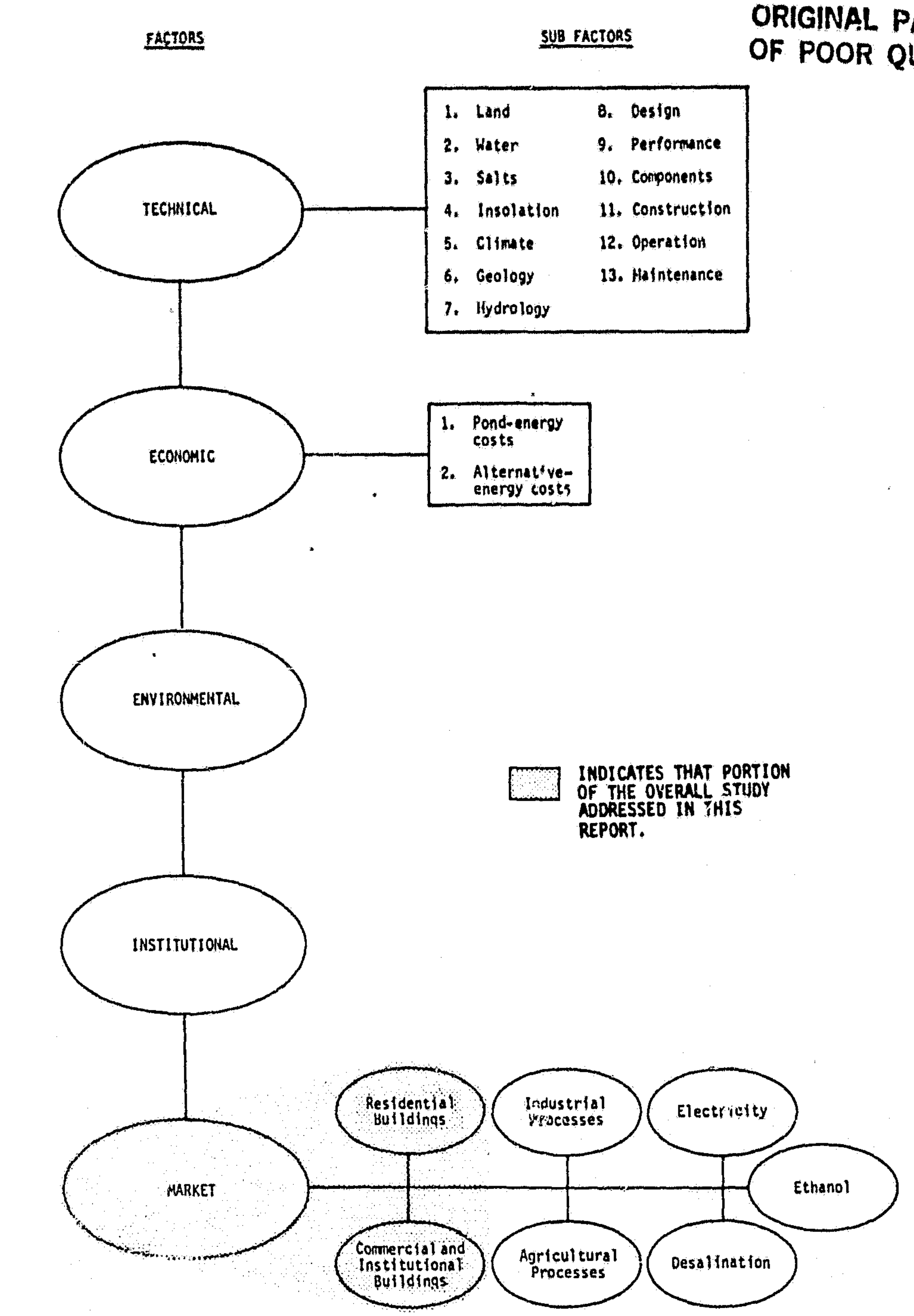

FIGURE 1.3-1

Factors Being Evaluated for the Solar Pond Application Studies

and too many regions could become burdensome and unmanageable. Preferably the total number of regions should be between 10 and 20.

2. Regions defined should reflect either different degrees of availability of the four essential natural resources or different climatic or geological conditions.

3. It is desirable that regional boundaries follow state boundaries as much as possible for consistency in gathering information. Where regional boundaries must cut through states, simple straight boundaries are preferred.

Primary factors assessed in establishing regional definitions included solar insolation levels, water and salts availability, and temperature distribution. Secondary factors that are mainly site specific and, therefore, not heavily weighted in regional definition include land availability and cost, topography, groundwater depth, soil conditions, seismic activity, wind velocity, and hurricane and tornado occurrences. The above-mentioned analysis resulted in the specific definition of 12 regions within the United States and Puerto Rico. Figure 1.3-2 depicts these 12 regions, and Table 1.3-1 lists the 12 regions and the states contained within each region.

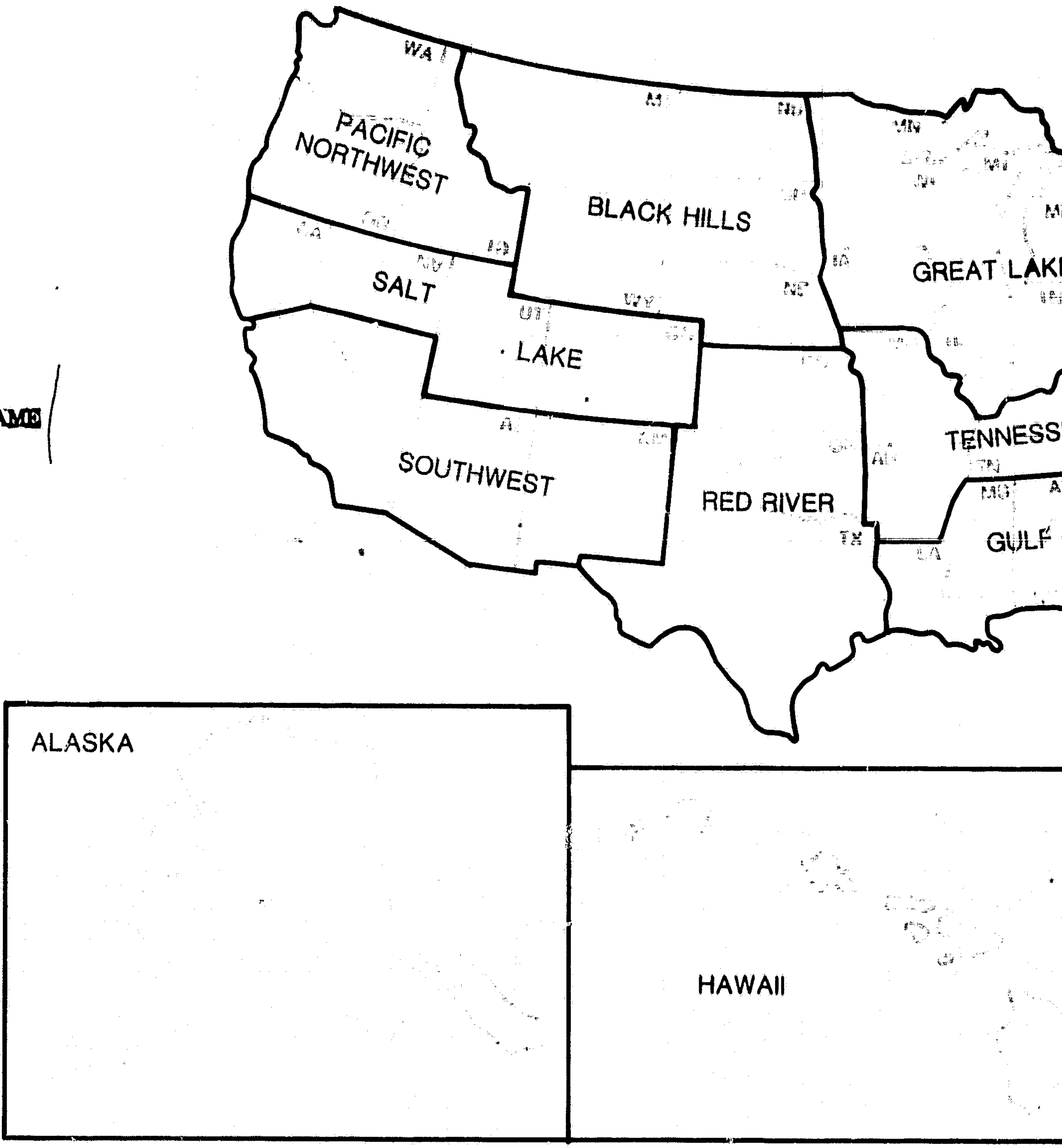

FIGURE 1.3-2
Regions to be Evaluated
for the Solar Pond
Applicability Studies

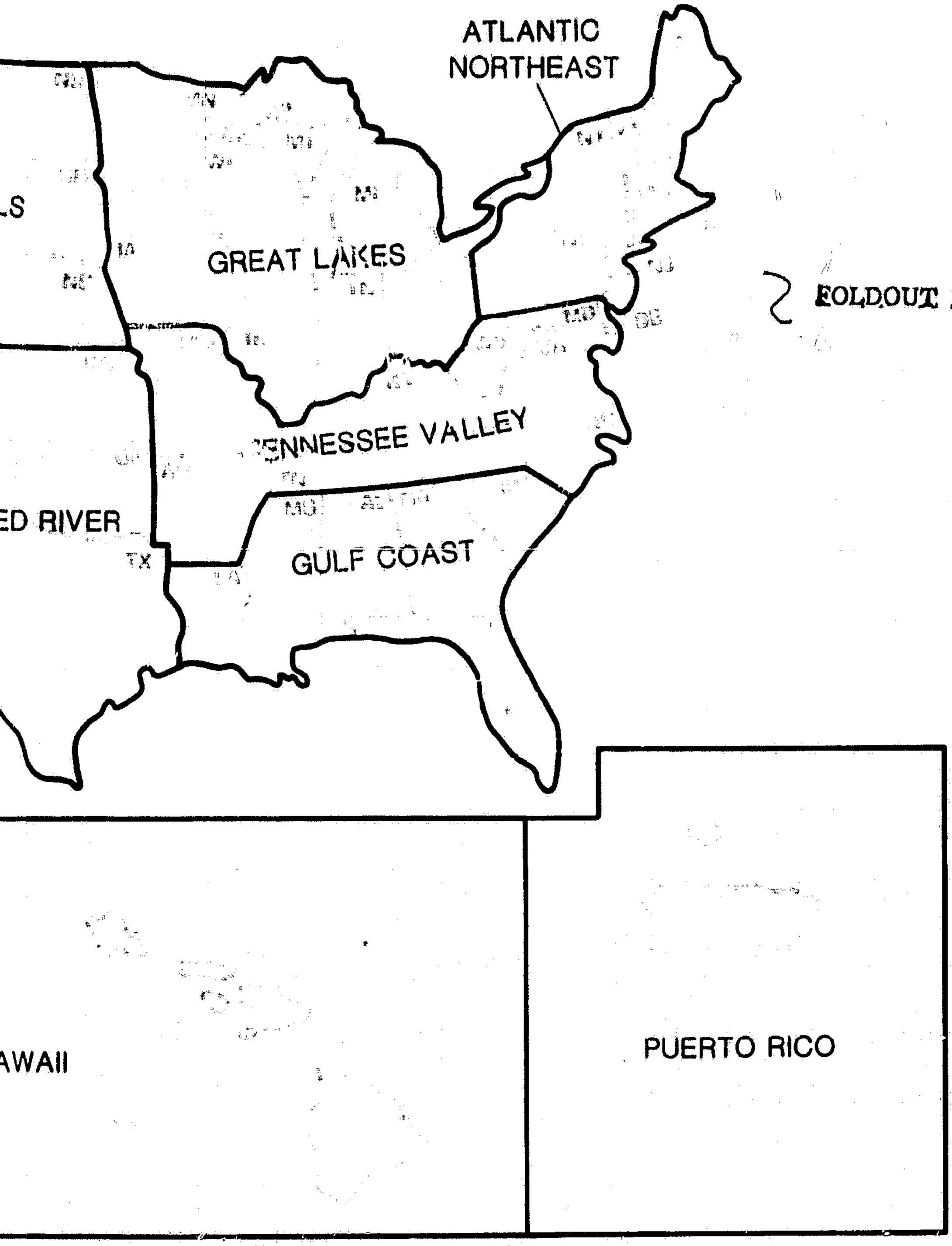

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TABLE 1.3-1

Solar Pond Regions

Region	State/Territory
Alaska	Alaska
Atlantic Northeast	Connecticut Maine Massachusetts New Hampshire New Jersey New York Pennsylvania Rhode Island Vermont
Black Hills	Montana Nebraska North Dakota South Dakota Wyoming
Great Lakes	Illinois Indiana Iowa Michigan Minnesota Ohio Wisconsin
Gulf Coast	Alabama Florida Georgia Louisiana Mississippi South Carolina
Hawaii	Hawaii
Pacific Northwest	Idaho Oregon Washington
Puerto Rico	Puerto Rico
Red River	Kansas Oklahoma Texas

Table 1.3-1 -- Continued

Region	State/Territory
Salt Lake	California (northern) Colorado Nevada (northern) Utah
South West	Arizona California (southern) Nevada (southern) New Mexico
Tennessee Valley	Arkansas Delaware Kentucky Maryland Missouri North Carolina Tennessee Virginia West Virginia

2.0 CASE STUDY CITIES

2.1 INTRODUCTION

Similar to the selection of the regions, a systematic evaluation process was developed to select cities that would best represent the individual regions. This selection process is described in the following section.

2.2 SELECTION METHODOLOGY

The selection of case study cities involved an analysis of over 2,200 cities throughout the United States and Puerto Rico. A summary of the procedures employed in this undertaking follows:

1. A list of cities having populations greater than 10,000 was compiled from the County and City Data Book 1977 (U.S. Bureau of the Census 1978c). Population and land-area data were recorded for each city. This 1975 data provided the basis for the calculation of population density for each city listed.

2. Density values were analyzed for each of the nine continental regions through the use of a computer program. A mean density and standard deviation were calculated for each region.

3. Density values for each city were then ranked as low, medium, or high. This was accomplished by calculating high- and low-density thresholds based on the mean density for each region and the associated standard deviation. The mean density plus one standard deviation constituted the minimum population for a high-density ranking. The mean density minus one standard deviation determined the maximum population for a low-density ranking. The values between these two numbers constitute the medium-density category.

4. Through computer analysis, cities within each density category (low, medium, and high) were randomly selected as case study cities

for each of the nine continental regions. Additional criteria were then applied to determine if the city chosen was suitable for this study. Factors evaluated included physiography (slope, landforms), vegetative patterns, and the availability of U.S. Geological Survey land-use/land-cover maps. If the first randomly selected city did not meet the screening factors, the random selection process continued until all initial criteria were met. The above-mentioned process was not utilized for Alaska, Hawaii, Puerto Rico, or the medium-density city for the Salt Lake region.

Exhibit A of Appendix A summarizes the results of the regional analysis. Over 2,200 cities were evaluated and categorized as low-, medium-, or high-density. As expected, all regions have more cities in the medium-category range than either of the other two categories. There is a significant difference among regions for the threshold values that define the high- and low-density categories.

It is noted and emphasized that the data presented in exhibit A of Appendix A reflect 1975 data and may not reflect current results obtainable from the recent 1980 census. Based upon time constraints and the need to select the cities from a comprehensive data source, the 1975 data were the most readily available and the most comprehensive source to utilize in the selection process. In some instances there may be categorical changes reflected in the current data that may not be representative of trends found in the 1975 information.

2.3 INVENTORY OF CASE STUDY CITIES

The previously described analysis resulted in the selection of 30 case study cities for general analysis of land availability and land values. Table 2.3-1 presents the selected low-, medium-, and high-density cities for each region, and Figure 2.3-1 identifies and locates each city.

Table 2.3-2 summarizes the 1975 and 1980 population and land-area data for the case study cities. The reader should be aware that the 1980 data could

TABLE 2.3-1

Population Density Summary of Case Study Cities

Region	Low Density			Medium Density			High Density		
	City/State	Density $(/mi^2)^a$	Category Range	City/State	Density $(/mi^2)^a$	Category Range	City/State	Density $(/mi^2)^a$	Category Range
Alaska				Anchorage, AK (28)[b]	3,170	137-9,281			
Atlantic Northeast	Derry, NH (27)	436	≤716	Brockton, MA (26)	4,523	717-5,949	Wilkes Barre, PA (25)	8,513	≥5,950
Black Hills	Pierre, SD (11)	1,082	≤1,986	Bozeman, MT (10)	2,835	1,987-4,035	Omaha, NB (12)	4,586	≥4,036
Great Lakes	Oregon, OH (17)	654	≤1,067	Madison, WI (16)	3,241	1,608-5,166	Euclid, OH (18)	6,087	≥5,167
Gulf Coast	Bainbridge, GA (24)	760	≤970	Birmingham, AL (23)	3,345	971-4,037	Baton Rouge, LA (22)	6,491	≥4,038
Hawaii				Honolulu, HI (29)	3,872[c]	2,837-7,557			
Pacific Northwest	Klamath Falls, OR (3)	1,364	≤1,461	Pendleton, OR (2)	1,774	1,462-3,828	Seattle, WA (1)	5,826	≥3,829
Puerto Rico				San Juan, PR (30)					
Red River	Oklahoma City, OK (14)	576	≤914	Waco, TX (15)	1,361	915-3,285	Liberal, KS (13)	3,726	≥3,286
Salt Lake	Carson City, NV (5)	166	≤1,494	Durango, CO (6)	3,678	1,495-4,209	Davis, CA (4)	5,118	≥4,210
South West	Scottsdale, AZ (8)	1,330	≤1,650	Carlsbad, NM (9)	1,822	1,651-6,115	Whittier, CA (7)	6,212	≥6,116
Tennessee Valley	Liberty, MO (19)	515	≤1,036	Roanoke, VA (21)	3,781	1,037-4,242	Columbia, MO (20)	8,430	≥4,243

Source: U.S. Department of Commerce 1978 (density figures).

[a] 1975 data.

[b] These numbers identify the cities found on Figure 2.3-1.

[c] 1970 data.

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KEY TO LEGEND FOR FIGURE 2.3-1

Number	City/State
1	Seattle, WA
2	Pendleton, OR
3	Klamath Falls, OR
4	Davis, CA
5	Carson City, NV
6	Durango, CO
7	Whittier, CA
8	Scottsdale, AZ
9	Carlsbad, NM
10	Bozeman, MT
11	Pierre, SD
12	Omaha, NB
13	Liberal, KS
14	Oklahoma City, OK
15	Waco, TX
16	Madison, WI
17	Oregon, OH
18	Euclid, OH
19	Liberty, MO
20	Columbia, MO
21	Roanoke, VA
22	Baton Rouge, LA
23	Birmingham, AL
24	Bainbridge, GA
25	Wilkes Barre, PA
26	Brockton, MA
27	Derry, NH
28	Anchorage, AK
29	Honolulu, HI
30	San Juan, PR

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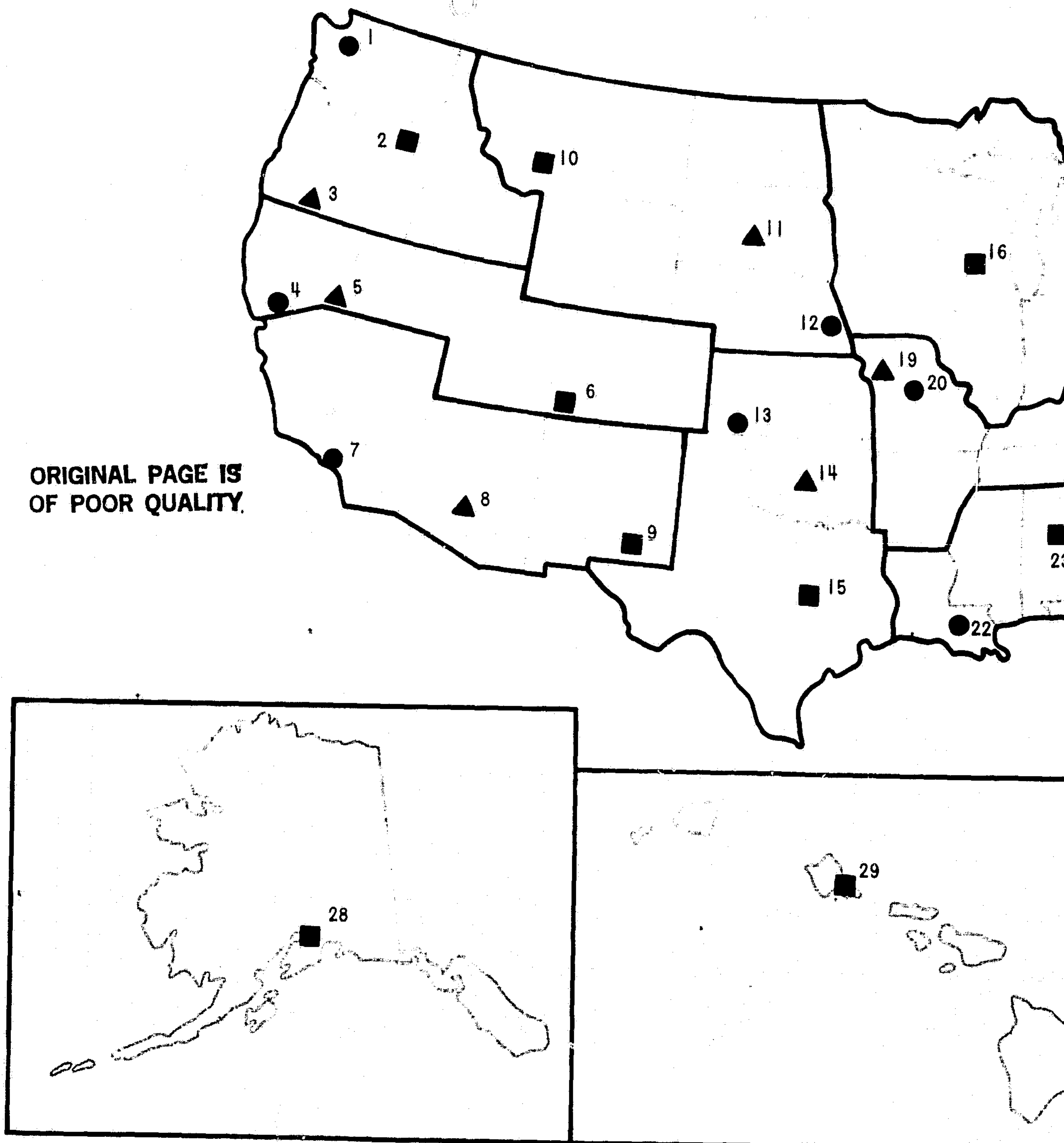

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FIGURE 2.3-1
Location of Case Study Cities

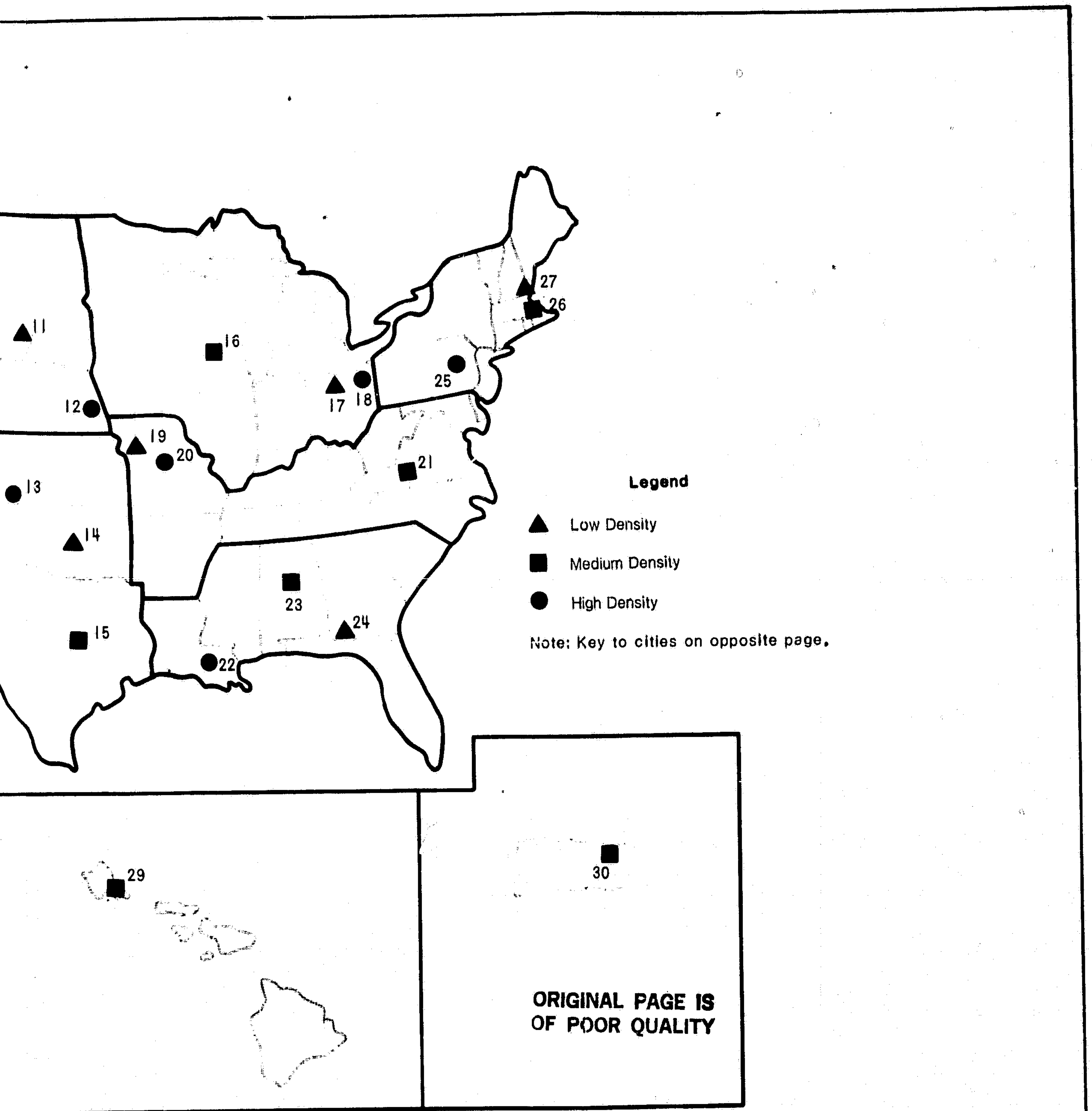

FIGURE 2.3-1
...on of Case Study Cities

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TABLE 2.3-2

Population and Land-Area Data for the Selected Case Study Cities

Region	City/State	1975 Data[a]		1980 Data[c]		Percent Population Change 1975-1980
		Population	Land Area[b]	Population	Land Area[b]	
Alaska	Anchorage, AK	161,018	50.8	173,017	165.0	+7.5
Atlantic Northeast	Brockton, MA	95,878	21.2	95,000	21.0	-1.0
	Derry, NH	15,259	35.0	20,000	37.0	+31.1
	Wilkes-Barre, PA	57,040	6.7	51,117	7.6	-10.4
Black Hills	Bozeman, MT	19,847	7.0	21,645	7.8	+9.1
	Omaha, NB	371,455	81.0	315,000	92.5	-15.2
	Pierre, SD	11,144	10.3	11,996	11.0	+7.1
Great Lakes	Euclid, OH	63,307	10.4	59,999	10.3	-5.2
	Madison, WI	168,196	51.9	178,000	52.0	+5.8
	Oregon, OH	18,500	28.3	18,500	28.4	0.0
Gulf Coast	Bainbridge, GA	10,722	14.1	10,513	15.0	-1.9
	Baton Rouge, LA	310,922	47.9	219,486	63.9	ADD[e]
	Birmingham, AL	276,273	82.6	284,388	98.0	+2.9
Hawaii	Honolulu, HI	324,871	83.9	762,874	603.8	+135.0
Pacific Northwest	Klamath Falls, OR	16,242	11.9	16,682	15.8	+2.7
	Pendleton, OR	13,662	7.7	14,549	8.6	+6.5
	Seattle, WA	487,091	83.6	493,850	91.6	+1.4
Puerto Rico	San Juan, PR	851,247[d]				
Red River	Liberal, KS	14,533	3.9	16,500	6.3	+13.5
	Oklahoma City, OK	365,916	635.7	401,577	621.0	+9.7
	Waco, TX	97,607	71.7	101,267	86.3	+3.7
Salt Lake	Carson City, NV	24,928	150.4	32,022	150.0	+28.5
	Davis, CA	32,243	6.3	36,626	7.0	+13.6
	Durango, CO	11,771	3.2	13,000	3.4	+10.4
South West	Carlsbad, NM	22,955	12.6	25,952	20.5	+13.1
	Scottsdale, AZ	77,529	58.3	88,400	88.6	+14.0
	Whittier, CA	72,059	11.6	68,872	12.1	-4.4
Tennessee Valley	Columbia, MO	63,227	41.7	62,061	42.0	-1.8
	Liberty, MO	14,991	29.1	16,300	19.5	+8.7
	Roanoke, VA	100,585	26.6	100,428	42.0	-0.2

[a] The source for the 1975 data is the County and City Data Book 1977 (U.S. Bureau of the Census 1978). This is the data base used to calculate the population density of over 2,200 cities in the U.S. and Puerto Rico. It is from the 1975 data that the cities were selected. At the time the cities were selected (May 1981), this was the most comprehensive up-to-date source that was readily available.

[b] Reported in square miles.

[c] These data were derived from many different sources and represent the most up-to-date information available. Each data entry was provided by the appropriate city planning official and is their best estimate of the 1980 population and land area. There are some apparent discrepancies with some of these data and the 1975 data (i.e., Baton Rouge population). See Table 3.2-1 for the data source for each city.

[d] 1970 population of San Juan metro area.

[e] Apparent data discrepancy (no percentage calculated).

reflect different density values than those obtained for 1975 and could conceivably result in a change of density category for a particular city when compared with the 1975 analysis. It is emphasized that the 1975 data base has been used throughout for determining density categories and selecting the cities. The 1980 data is presented only to provide a basis for comparison and to present existing conditions.

The last column of Table 2.3-2 analyzes the percentage of population change for each city. The greatest percentage growth in the continental United States is evident for the city of Derry, New Hampshire, that is atypical of the Atlantic Northeast region, but the growth is representative of the flight from the large urban areas to rural settings. The three regions showing cities with significant population increases are the Red River, South West, and Salt Lake regions. These data are typical of the trends for migration to the western, south-central, and southwestern portions of the country. Of all the cities studied, Honolulu shows the largest increase in population, mostly attributable to the annexation of large amounts of land.

The following chapters are designed to make general evaluations of the land availability and land values in each of the cities and to make regional projections based on the data base provided for each city.

3.0 CASE STUDY CITY
ANALYSIS OF LAND AVAILABILITY AND LAND VALUES

3.1 INTRODUCTION

This chapter presents and analyzes the baseline data acquired from each of the 30 cities selected for evaluation. Included in the discussion for each city are sections on geography, land use/land availability, and land values. Following is a summary of the methodology employed in gathering and evaluating the data.

3.2 DATA COLLECTION AND ANALYTICAL METHODOLOGY

3.2.1 DATA COLLECTION

Data for this type of study are not readily available nor easily accessible. Published information is general and sporadic, and availability depends in part on the emphasis placed on the planning programs within each of the cities. Land-use data, land-availability information, and zoning regulations, in most cases, were obtained from city or community officials. Information regarding land values was obtained from realtors, appraisers, and/or city/community officials. Land-value data are not ordinarily published since the presented information represents local trends and estimates as determined by the individuals contacted.

3.2.1.1 Data Contacts

Initial contacts regarding this study were made through telephone interviews that utilized a prepared questionnaire for gathering information. An example of that questionnaire is presented as exhibit B of Appendix A. In many instances, it was necessary to follow up these phone calls with written requests regarding the desired information. An example of one such request is presented as exhibit C of Appendix A.

Much of the success in completing this study is dependent upon the cooperation exhibited by the local people contacted. The project scope and schedule did not allow for a comprehensive in-depth literature review, site visit, and analysis of each city; therefore, the information supplied by the local officials plays a large role in the validity and accuracy of this study. Table 3.2-1 lists those individuals contacted in each of the case study cities.

3.2.2 ANALYTICAL METHODOLOGY: LAND AVAILABILITY

The analyses that take place in this chapter require that the reader have a thorough understanding of a variety of standard terms and some new terms (phrases) that have been developed to facilitate the discussion. Without this knowledge, there would be some difficulty in understanding the various interpretations. Following are brief explanations of the significant terms:

Residential land use refers to housing or living units occupied on a non-transient basis and may include single family structures, duplexes, townhomes, or apartments (multifamily structures).

Commercial uses are those that are concerned with the distribution, sale, or rental of goods. These uses may range from candy stores to supermarkets, poodle grooming shops to truck stops, used car lots to heavy farm equipment sales.

Institutional uses refer to utility, educational, recreational, cultural, medical, protective, governmental, and other uses that are strongly vested with public or social importance. Typical uses include schools, universities, hospitals, wastewater treatment plants, and other uses.

Developed land has a primary structure or use in place.

Undeveloped land has water, sewer, and other utilities either on site or readily accessible but does not have any structures in place.

TABLE 3.2-1

Individuals Contacted for Land-Use/Availability and Land-Value Data

		Land Use/Availability			Land Values		
Region	City/State	Name/Title	Address	Phone Number	Name/Title	Address	Phone Number
Alaska	Anchorage, AK	Tom Nelson/ Senior Planner	Municipality of Anchorage 632 W. 6th Ave. Anchorage, AK 99502	907/264-4219	Angie Dugick/ Consultant	621 W. Diamond Anchorage, AK 99502	907/344-67?3
Atlantic Northeast	Brockton, MA	Abby Kramer/ Planner	Office of the City Planner City Hall Brockton, MA 02041	617/580-1100	Dick O'Flaherty/ Assessor	Assessor's Office City Hall Brockton, MA 02041	617/580-1100
	Derry, NH	Fred L. Piper, Jr./ Building Inspector Health Offices	Town of Derry Office of the Building Inspector Derry, NH 03038	603/432-7553	Pat Demairis/ Realtor	Demairis Realty Derry, NH	603/432-7744
	Wilkes-Barre, PA	Mark Kutney/ Assistant Director	Room 45 City Hall Wilkes-Barre, PA 18711	717/826-8254	Ann Hutter	Redevelopment Authority Wilkes-Barre, PA 18711	717/829-1381
Black Hills	Bozeman, MT	Paul Bolton/ Planning Director	City of Bozeman P.O. Box 640 Bozeman, MT 59715	406/586-3321	Ms. Mike Shine	Appraisal Assoc. 124 W. Curtis Bozeman, MT 59715	406/586-2535
	Pierre, SD	Mary Lu Goehring/ Administrative Assistant	Division of Public Works P.O. Box 1253 Pierre, SD 57501	605/224-7341	Terry Barge/ Appraiser	Poulos & Barge Realty 320 E. Capital Pierre, SD 57501	605/224-5975
	Omaha, NB	Blythe Kubovec/ City Planner	Room 1110 Civic Center 1819 Farnham Omaha, NB 68183	402/444-5200	Mel Strong	Harvey Real Estate 304 S. 41st Omaha, NB 68131	402/342-6020
Great Lakes	Euclid, OH	Walter Hoag/ Assistant Director for Community Development	City of Euclid 21331 Wilmore Ave. Euclid, OH 44123	216/289-2700	Nadine Slechta/ Sales manager	Pena Realty, Inc. 27801 Euclid Ave. Euclid, OH 44132	216/289-0300
	Madison, WI	Joel Peterson/ Planner	City of Madison 215 Minona Ave. Madison, WI 53710	608/266-4635	Ed Hart/ City Appraiser	City of Madison 210 Minona Ave. Madison, WI 52710	608/266-4531

TABLE 3.2-1 -- Continued

		Land Use/Availability			Land Values		
Region	City/State	Name/Title	Address	Phone Number	Name/Title	Address	Phone Number
	Oregon, OH	A. J. Horvath/ Administrative Assistant Don Surface/ Service Director	Department of Public Safety and Service City of Oregon 5330 Seaman Road Oregon, OH 43616	419/698-7071	Rod Mohan/ Realtor	Mohan Realty 2035 Woodville Oregon, OH 43616	419/698-4568
Gulf Coast	Bainbridge, GA	David Aldrich/ Planner	Community Development Department City of Bainbridge P.O. Box 158 Bainbridge, GA 31717	912/246-7800	David Booker	Bainbridge Chamber of Commerce P.O. Box 736 Bainbridge, GA 31717	
	Baton Rouge, LA	Richard Barker/ Planner	805 St. Louis P.O. Box 1471 Baton Rouge, LA 70821	504/389-3144	Richard Barker/ Planner	Same	Same
	Birmingham, AL	Bill Moody/ Senior Planner	Community Development Department 710 North 20th Birmingham, AL 35203	205/254-2680	C.H. Chichester, Jr.	Chichester & Co. 1105 John A. Hand Bldg. Birmingham, AL 35203	205/251-6543
Hawaii	Honolulu, HI	Steve Young/ Planner	General Planning City of Honolulu 650 S. King St. Honolulu, HI 96813	808/523-4404	Jack Aldridge/ Realtor	Barefoot Realty 4747 Kilanea Ave. Honolulu, HI 96816	808/732-1431
Pacific Northwest	Klamath Falls, OR	Jerry Green/ Senior Planner	P.O. Box 237 Klamath Falls, OR 97601	503/883-5360	Dean Sacher/ Appraiser	226 Pine Klamath Falls, OR 97601	503/884-1351
	Pendleton, OR	Edward Rhodes/ Director of Planning and Building	P.O. Box 190 Pendleton, OR 97801	503/276-1811	Jerry Imsland/ Realtor	Davis & Imsland Real Estate 146 S. Main Pendleton, OR 97801	503/276-8245
	Seattle, WA	Jean Moehring/ Planning Analyst	Office of Neighborhood Planning and Community Development Seattle, WA 98104	206/625-4725	Charles Peterson/ Appraiser	Peterson Appraisal Suite 202 4210 198 St. SW Linwood, WA 98036	206/776-1108

TABLE 3.2-1 -- Continued

		Land Use/Availability			Land Values		
Region	City/State	Name/Title	Address	Phone Number	Name/Title	Address	Phone Number
Puerto Rico	San Juan, PR	Jose Barreto/ Consultant	Cond. Torre del Mar Apt. 1504 1477 Ashford Ave., Condado Santurce, Puerto Rico 00907	809/722-6966	Jose Barreto/ Consultant	Same	Same
Red River	Liberal, KS	Carol Hansen/ Administrative Assistant	City of Liberal P.O. Box 830 325 N. Washington Ave. Liberal, KS 67901	316/624-0101	Lowell Bushart/ Realtor	Bushart Realtors Box 188 Liberal, KS 67901	316/624-3814
	Oklahoma City, OK	Jeffrey Minar/ Associate Planner	100 N. Walker 1st Floor Oklahoma City, OK 73102	405/231-2816	Larry Rice/ Appraiser	Oklahoma Appraisal Company Commercial Div. 2800 N.W. 36th Oklahoma City, OK	405/947-8722
	Waco, TX	William D. Ringo/ Director of Planning Admin.	P.O. Box 1370 Waco, TX 76703	817/756-6161	Jim Stewart/ Owner	Jim Stewart Realty 7535 Bosque Blvd. Waco, TX 76710	817/776-0000
Salt Lake	Carson City, NV	Walter Sullivan/ Senior Urban Planner	2621 Northgate Lane Suite 54 Carson City, NV 89701	702/887-2[illegible]	Nancy Copp/ Realtor	Sierra Land Realty 711 South Carson Carson City, NV 89701	702/882-4834
	Davis, CA	Jessie Keller/ Planning Technician	City of Davis 23 Russell Road Davis, CA 95616	916/756-3740	Ann Mauvis/ Realtor	Mauvis Realty 213 G. Street Davis, CA 95616	916/753-6040
	Durango, CO	Craig Roser/ Planner	LaPlata County P.O. Box 2160 Durango, CO 81301	303/259-1440	Troy Willis/ Appraiser	Willis Appraisals 4556 County Rd. 240 Durango, CO 81301	303/[illegible]47-2255
South West	Carlsbad, NM	Don Patterson/ Community Development Director	101 Halagueno St. P.O. Box 1569 Carlsbad, NM 88220	505/887-1191	Bill Williamson/ Appraiser	Montgomery Agency Box 1568 Carlsbad, NM 88220	505/885-4131
	Scottsdale, AZ	Don Hadder/ Planner	City of Scottsdale 3939 Civic Center Plaza Scottsdale, AZ 05251	602/994-2318	Don Hadder/ Planner	Same	Same
	Whittier, CA	Chip Leslie/ Assistant Planner	City of Whittier 13230 East Penn St. Whittier, CA 90602	213/698-2551	Tom Dotson/ Appraiser	TFD 8156 S. Painter Whittier, CA 90602	213/698-0911

TABLE 3.2-1 -- Continued

		Land Use/Availability			Land Values		
Region	City/State	Name/Title	Address	Phone Number	Name/Title	Address	Phone Number
Tennessee Valley	Columbia, MO	Bart Elliot/ City Planner	City Planning Dept. P.O. Box N Columbia, MO 65205	314/874-7239	Roy Willie/ Appraiser	Roy Willie Real Estate Box 595 Columbia, MO 65205	314/443-3175
	Liberty, MO	Larry Mangan/ Planner	Community Development Department P.O. Box 159 Liberty, MO 64068	816/781-7100	Leo Oberfoell/ Realtor	Century 21 361 S. 291 Highway Liberty, MO 64068	816/781-2900
	Roanoke, VA	Ted Tucker/ Planner	Office of Community Planning Room 355 Municipal Building 215 Church Ave. SW Roanoke, VA 24011	703/981-2344	Betty Kirkland/ Appraiser	Appraisal Services P.O. Box 8365 Roanoke, VA 24104	703/989-0133

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Raw land is undeveloped land that does not have utilities in place or available for extension.

Pond-suitable land (PSL) is a general term that has been identified for this study to describe the amount of land that might potentially be available for the installation of solar ponds either in existing or future developments. The percentage of PSL varies with the land-use category and the region in which it is found. In existing developments, the PSL essentially refers to the amount of space dedicated to rear yards in single family developments and the available open space surrounding a commercial or institutional development. For future developments on undeveloped land, PSL is the amount of land (rear yards, etc.) that could potentially be incorporated into urban designs for solar pond development as restricted by zoning ordinances. Both of the concepts are dependent upon the specific zoning ordinances of a given city and the minimum and maximum lot sizes and lot coverage.

Total PSL is the total amount of estimated PSL that can be extracted from both developed and undeveloped portions of a city or region. Developed PSL primarily would involve retrofit activities and would be more difficult to utilize. Undeveloped PSL could be incorporated into planning activities and utilized for future developments. It will be the undeveloped PSL data that will be emphasized in this report. Pond-suitable land estimates are made for the three land-use categories -- residential, commercial, and institutional.

Single family/multifamily PSL is a further refinement of the developed or undeveloped residential PSL based upon a national average percentage breakdown.

In determining the availability of land within each of the case study cities, it is necessary to evaluate the amount of developed and undeveloped land. Once these parameters have been defined, it is then necessary to evaluate the amount of land that would be potentially suitable for solar ponds. Following is the discussion regarding the methodology employed in analyzing developed and undeveloped PSL.

3.2.2.1 Developed Land

The diversity of land-use planning procedures used by the various city planning agencies or departments necessitated the development of a general methodology for calculating land uses, but one with sufficient flexibility to take into account the variability in the data sources. This methodology follows:

> Determine the total amount of land area in each city (expressed as "total acres");
> determine the amount of developed land and the amount of undeveloped land in each city (expressed as "developed acres" and "undeveloped acres");
> determine the amount of developed land devoted to each of the following land uses: (1) residential, (2) commercial, and (3) institutional; and
> translate the referenced specific land uses (i.e., residential, commercial, and institutional) into percentages and express each as a percentage of the developed acres (e.g., commercial land use constitutes "X" percent of the developed land in a given city).

In most instances, the city planning agencies or departments treat miscellaneous uses (streets, highways, etc.) as a separate land use, and in those cases, no adjustment to the general methodology outlined above was necessary. In a few instances, however, adjustment was necessary. Some cities, for example, report total land area, exclusive of miscellaneous land uses (MLU). If the city-supplied data revealed the additional land area was devoted to MLU, an adjustment was made by adding this additional amount of land area to obtain a true total land-area figure. If no data were given on this additional amount of land area, an estimate was used. An additional 28 percent was added to the total land area to account for the standard of 25 percent to 30 percent of land area of a city that is devoted to MLU.

Some communities do not report MLU as a separate entity but include the amounts with the other adjoining land uses. For instance, a city might report that "X" percent of its developed land is in residential use when, in

fact, the "X" percent included the MLU abutting the residential property. In these cases, an estimate of 28 percent of the developed land area was subtracted from the developed land-use categories.

Residential, commercial, and institutional classifications represent broad categories of land use and in no way exhaust the possibilities of land use in any given city. Additional land uses would include categories such as industrial, open space (parks, etc.), and certain office building or complex classifications, in addition to the aforementioned MLU. For this reason, the total residential, commercial, and institutional land-use acreage will not equal the total developed land area in the selected cities.

3.2.2.1.1 Residential Open Land

A key piece of data required for this study is the percentage of PSL available within the developed areas. This PSL excludes paved areas (streets, driveways, etc.), and in regard to solar pond application is only realistic if it includes those areas currently dedicated to rear yards. It is assumed that realistic retrofit applications of solar pond technology would not include front yards of private residences because typical subdivision regulations preclude front yard development.

The amount of PSL available is expressed as a percentage of the developed area. This percentage is determined based on zoning-ordinance information concerning maximum lot coverage (or required open space). For consistency and to develop a reasonable data base for residential development in a given region, maximum lot coverage percentages for the three cities within a region were averaged to determine a consistent data base to be used for the region. This method of application allows for regional consistency. The regional average approach for residential areas will give a general indication of lot-development tendencies within a given region.

The residential regional percentage of PSL reflected in the data does not include areas dedicated to front yards. The percentage shown is actually half the percentage of required open space available since the assumption has been made that front yards are not realistic sites for solar pond

development. In other words, if a given region is determined to have 70-percent required open space available in the developed residential area, this number is divided by two to arrive at a regional figure; thus, 35 percent of the developed area (rear yards) would be potentially available for solar ponds.

3.2.2.1.2 Commercial/Institutional Pond-Suitable Land

In many instances, zoning ordinances for most of the case study cities do not contain requirements for maximum use intensity or maximum lot coverage for commercial and institutional land uses. For analytical purposes, a substitute methodology has been incorporated to determine the land-use impact for these land-use types. Since a small (3 or 4-story) apartment building uses approximately the same amount of land as a comparable commercial building, a national average of 67 percent is used to estimate the undeveloped land-use percentage for commercial and institutional uses (Bair 1967). As with the residential sectors, to account for rear space only, this number is divided in half to arrive at a realistic percentage. For purposes of this report, 34 percent of all commercial/institutional land areas will be considered suitable space for solar pond development. This percentage will be applied to all 12 regions due to a deficiency of consistent and refined regional data.

3.2.2.1.3 Building Unit Analysis

Another important analysis involves the evaluation of the existing zoning codes to determine the maximum number of units permitted under a city's zoning code. Land-use/land-availability tables will be presented for each city. Columns 8 through 13 of these tables (see Table 3.3-1) determine the maximum number of units that can exist on the developed and undeveloped land. It is very important that the reader understand that the building unit estimates are probably high. Very few cities develop at the maximum permitted by the zoning code. The numbers developed here are general and do have a significant effect on the subsequent square footage calculations. Exhibit D of Appendix A describes the background methodology used in determining the range of potential units. Data in columns 10 through 13

(Table 3.3-1) present the range of units that could exist for each land-use category.

3.2.2.2 Undeveloped Land

While planning agencies or departments were able to supply data concerning the amount of undeveloped land in each city, detailed information on the specific future use of the land was not readily available. In most cities, a large portion of the undeveloped land is classified as "agricultural," although it is destined for future development as one or more of the traditional urban-land uses. In a limited number of cases, cities indicated that a certain amount of the undeveloped land eventually would be used (and, therefore, is currently set aside) for industrial parks or city-owned parks and open space.

In those instances in which specific portions of the undeveloped land were set aside for future nonresidential, noncommercial, or noninstitutional use, the total amount of undeveloped land was reduced accordingly. Otherwise, no adjustment was made to the city-supplied data on undeveloped land area.

The undeveloped land area (adjusted or as supplied) served as the base for calculating future residential, commercial, and institutional land uses. This base was multiplied by the percentage figures derived in the calculations on developed land use. In other words, future land use in the undeveloped portion of each city (expressed as "undeveloped residential," "undeveloped commercial," and "undeveloped institutional") was allocated on the basis of existing or current land-use patterns.

3.2.2.2.1 Building Unit Analysis

For a detailed description of this analysis, the reader is referred to section 3.2.2.1.3.

3.2.3 ANALYTICAL METHODOLOGY: SINGLE FAMILY/MULTIFAMILY INFORMATION

Residential land can be divided into single family and multifamily categories. To better define this relationship as it exists within a city, a national percentage has been used to determine this breakdown for each case study city. For purposes of this analysis, 87 percent of all existing developed and undeveloped land will be considered as existing or future single family uses, whereas 13 percent of all land will be considered as multifamily (Chapin and Kaiser 1979). By applying these percentages to the amount of developed and undeveloped land, it is possible to calculate the amount of land dedicated to each use (Table 3.3-2).

Another pertinent piece of data is the amount of square footage available for single family and multifamily use within a given city. This is a very difficult number to obtain based on the level of detail of this study. An attempt has been made to quantify the potentially available square footage for the single family/multifamily categories. It has been determined that 68 percent of all residential units are single family and 32 percent are multifamily (U.S. Bureau of the Census 1978a). In addition, the average square footage per unit for single family and multifamily units is 1,535 and 906 square feet, respectively (U.S. Bureau of the Census 1976, 1977, 1978, 1979, 1980, 1981).

The above-mentioned data are national averages and are not intended to represent specific information for a given city. By using the above-mentioned information and determining the average number of units that could exist under the various zoning codes, the total amount of square feet in each category can be calculated using the following equation:

$$A \times B \times C = D$$

where,

A = unit percentage breakdown;

B = average number of units;

C = average square feet per unit; and

D = total square feet per city.

For a working example, the reader is referred to the lower data set of Table 3.3-2. These data are not site specific, take into account numerous assumptions, and therefore reflect very general estimates.

3.2.4 ANALYTICAL METHODOLOGY: LAND VALUES

Assessing general land values in a community is a difficult task due to the many variables that make a particular parcel of land attractive. Variables include proximity to the urban area, availability of utilities and services, and the physical characteristics and intended use of the parcel itself. Another vital factor is the source of information because different realtors and appraisers provide varying estimates, thereby producing inconsistent definitions about land values.

For this study, land-value data were obtained through telephone contacts with realtors and appraisers in the selected cities. Low-, medium-, and high-range values were obtained for each of the defined land-use categories (residential, commercial, and institutional). In some cities/communities, land values are available by city sector. Evaluating sector data is much too detailed and cumbersome for this study and creates data base inconsistencies among the cities; therefore, all land-value data presented will reflect low, medium, and high costs for the entire city.

3.3 ANALYSIS OF CITIES

3.3.1 ALASKA REGION

The entire state of Alaska is a defined region for this study. One city has been selected for study in this region -- Anchorage. Figure 3.3-1 depicts the Alaska region and locates the case study city and reference cities. The following discussion is designed to evaluate the geographic characteristics, land use/availability, and land values in Anchorage.

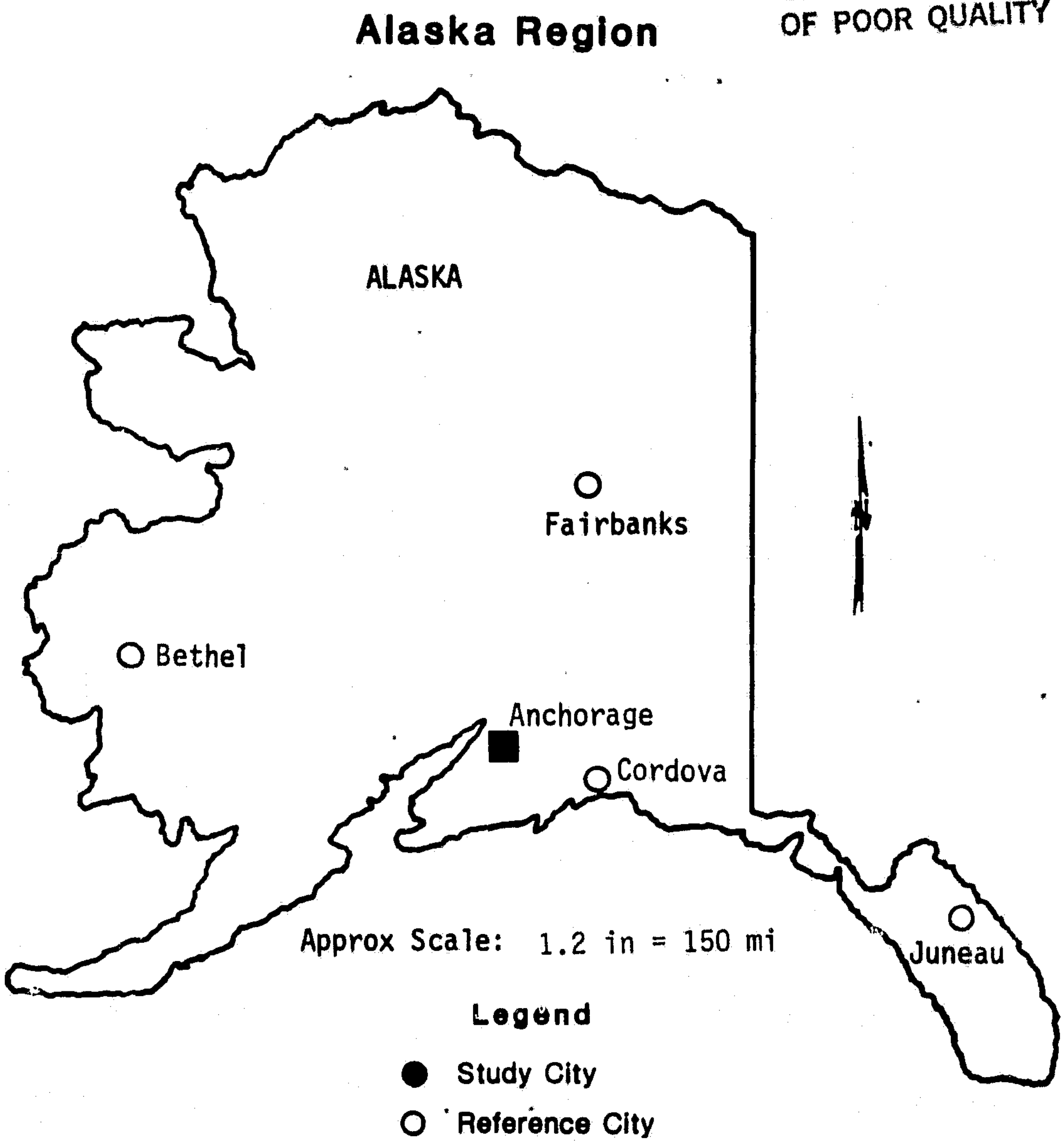

FIGURE 3.3-1

Location of Case Study Cities, Alaska Region

3.3.1.1 Anchorage, Alaska

3.3.1.1.1 Geography

Anchorage is located in the southwest corner of the southeast quadrant of the state and is the home of the University of Alaska at Anchorage. It is located in a transition zone between the Subarctic and Marine physiographic divisions and the Alaska Range and Pacific Forest Highland ecoregion provinces. The reported 1980 population for Anchorage is 173,017, and the land area is 165 square miles (Nelson 1981).

3.3.1.1.2 Land Use/Land Availability

Land carrying capacity is a significant land-use issue in Anchorage. The city is surrounded by mountains, glaciers, and water. Development is further limited by poor soils and unavailability of public utilities. In addition, development is dependent on outside growth factors including in migration, energy development, and Anchorage's role as a service center for the state.

Table 3.3-1 contains the land-use/land-availability information for Anchorage. Nearly 44 percent of the city's total land area is developed or reserved for development as institutional land uses. This is an unusually high ratio for institutional land use, especially since residential land comprises only 40 percent of the total.

Almost 66 percent of the total land is undeveloped. If this land develops at the maximum number of units permitted under the existing zoning code, this would create between 132,752 and 1,281,050 new residential units, between 18,573 and 55,717 new commercial units, and 80,602 new institutional units. The maximum number of units permitted under the existing zoning code for developed land is between 68,119 and 657,350 residential units, between 9,935 and 29,804 commercial units, and 41,369 institutional units. The range of total PSL for both developed and undeveloped property is between 25,295 and 27,233 acres.

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TABLE 3.3-1

Land Use/Land Availability
Anchorage, AK

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	38,768	13,147	25-30	3,287-3,944	25,621	25-30	6,405-7,686
Commercial	3,934	1,371	34	466	2,563	34	871
Institutional	41,958	14,231	34	4,839	27,727	34	9,427
Other (MLU)	11,340	3,802	--	--	7,538	--	--
Total (city)	96,000	32,551	--	8,592-9,249	63,449	--	16,703-17,984

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	8,400	.193	850	.020	68,119	657,350	132,752	1,281,050
Commercial[e]	6,000	.138	2,000	.046	9,935	29,804	18,573	55,717
Institutional[f]	15,000	.344	15,000	.344	41,369	41,369	80,602	80,602

Source: Nelson 1981.

[a] Data in column 2 divided by data in column 8.
[b] Data in column 2 divided by data in column 9.
[c] Data in column 5 divided by data in column 8.
[d] Data in column 5 divided by data in column 9.
[e] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f] Assume minimum lot sizes are the same as commercial.

Table 3.3-2 shows the single family/multifamily residential data. Total potential single family acreage is 33,728 acres. For multifamily, the potential acreage estimate is 11,622. Estimated total square feet of residential housing that could be served by solar ponds are nearly 484 million square feet for developed residential land and 943 million square feet for undeveloped land.

3.3.1.1.3 Land Values

Table 3.3-3 presents land-value data for Anchorage. The apparent discrepancy between the value for residential land ($4,000-25,000 per acre) and commercial and institutional lands ($217,800-1,742,400 per acre) is probably due to the difference between undeveloped and developed property. Land development in Anchorage is limited by poor soils, lack of utilities, glaciers, and large amounts of publicly owned lands.

3.3.1.2 Regional Summary

Figure C-1 of Appendix C graphically reflects PSL comparisons for Anchorage. For the undeveloped land in the city, the majority of it would be dedicated to institutional uses, as shown.

Figure D-1 of Appendix D compares the land values in the Anchorage area. Residential land is appreciably less expensive than commercial and institutional property. Commercial and institutional costs are rated the same, with the high range exceeding 1 million dollars.

3.3.2 ATLANTIC NORTHEAST REGION

The Atlantic Northeast region is comprised of the states of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The cities selected for study in this region include Derry, New Hampshire (low density); Brockton, Massachusetts (medium density); and Wilkes-Barre, Pennsylvania (high density). Figure 3.3-2 presents the Atlantic Northeast region and locates the case study cities and additional reference cities. The following discussion will evaluate the

TABLE 3.3-2

Single Family/Multifamily Residential Data
Anchorage, AK

Development Category	Developed Land					Undeveloped Land				
	Total Acres	Single Family		Multifamily		Total Acres	Single Family		Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	13,147	87	11,438	13	8,291	25,621	87	22,290	13	3,331

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	362,735	1,535	906	378,622,793	105,164,131	68	32	706,901	1,535	906	737,863,264	204,944,738

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-1.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-1.

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TABLE 3.3-3

Land Values
Anchorage, AK

Development Category	Range	Average Cost per Acre
Residential	Low	$ 4,000
	Medium	8,000
	High	25,000
Commercial	Low	217,800
	Medium	653,400
	High	1,742,400
Institutional	Low	217,800
	Medium	653,400
	High	1,742,400

Source: Dugick 1981.

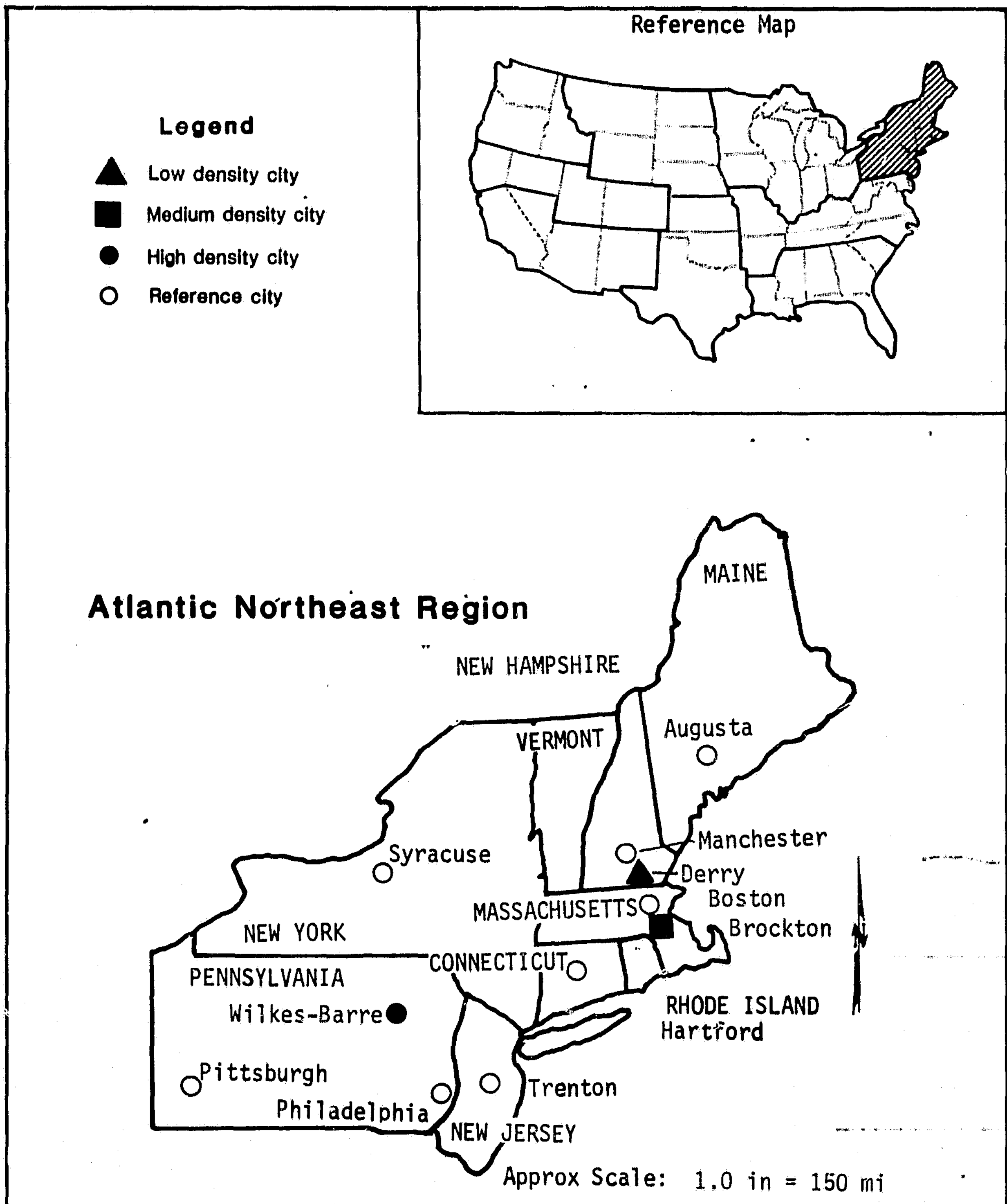

FIGURE 3.3-2

Location of Case Study Cities,
Atlantic Northeast Region

general geographic characteristics of each city, land use/availability, and land values.

3.3.2.1 Derry, New Hampshire

3.3.2.1.1 Geography

Derry is a small New England town located in southeastern New Hampshire southeast of Manchester and northwest of Boston. It is located in the Appalachian Highlands physiographic division, the New England province, Seaboard Lowland section. The area is characterized by eroded and glaciated peneplains and sporadic monadnocks (Fenneman 1946). The area is about 200 feet above mean sea level (msl) and is located due east of the Merrimack River. Ecologically, Derry is found in the Appalachian Oak Forest section. Vegetation consists of tall, broadleaf trees that develop a dense summer canopy creating a lower layer of shrubs and small trees (Bailey 1976). Soils consist of light-colored podzolic soils associated with forested regions (Strahler 1969). The reported 1980 population is 20,000, and the land area is 37 square miles (Piper 1981).

3.3.2.1.2 Land Use/Land Availability

Figure B-1 of Appendix B depicts the general land use in the vicinity of Derry. The city lies in a valley and is surrounded predominantly by forest land (category 4). Isolated residential areas (11) are evident in all directions.

Table 3.3-4 presents the land-use/land-availability information for Derry. Eighty percent of the total land available in the community is undeveloped land. Between 4,893 and 5,285 acres are PSL. Most of the PSL (approximately 84 percent) is within the residential land-use category.

Fred Piper, building inspector for Derry, reports that the city currently has a "very aggressive" number of housing starts vis-a-vis the rest of the region. Derry is an attractive "bedroom community" for people working in Northeastern Massachusetts.

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TABLE 3.3-4

Land Use/Land Availability
Derry, NH

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	12,965	2,593	32-35	830-908	10,372	32-35	3,319-3,630
Commercial	365	73	34	25	292	34	99
Institutional	1,825	365	34	124	1,460	34	496
Other (MLU)	8,525	1,705	--	--	6,820	--	--
Total (city)	23,680	4,736	--	979-1,057	18,944	--	3,914-4,225

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	10,000	.230	2,500	.057	11,274	45,491	45,096	181,965
Commercial[e]	10,000	.230	2,500	.057	317	1,281	1,270	5,123
Institutional[f]	10,000	.230	2,500	.057	1,587	6,404	6,348	25,614

Source: Piper 1981.

[a] Data in column 2 divided by data in column 8.

[b] Data in column 2 divided by data in column 9.

[c] Data in column 5 divided by data in column 8.

[d] Data in column 5 divided by data in column 9.

[e] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f] Assume minimum lot sizes are the same as commercial.

Table 3.3-5 contains single family/multifamily residential data. A total of 11,280 acres could develop for single family residential uses and 1,685 acres for multifamily use. An estimated 30 million square feet of single family and 8 million square feet of multifamily could exist in Derry. Future development could add another 152 million square feet of residential building space.

3.3.2.1.3 Land Values

Table 3.3-6 contains pertinent information on land values for Derry. Property appears to be relatively affordable for the area since undeveloped residential land is available for less than $20,000 per acre. There is currently a ban on new sewer hookups that is limiting commercial, industrial, and retail development. Residential construction remains steady (Piper 1981).

3.3.2.2 Brockton, Massachusetts

3.3.2.2.1 Geography

Brockton is located in southeastern Massachusetts, south-southeast of Boston, and supports a Veterans Administration Hospital and a community college.

It is located in the Appalachian Highlands physiographic division, the New England province, Seaboard Lowland section. The area is characterized by eroded and glaciated peneplains and sporadic monadnocks (Fenneman 1946). The area is about 150 to 200 msl, is mostly flat, and is located west of Massachusetts Bay.

Ecologically, Brockton is in the Appalachian Oak Forest section. Vegetation consists of tall, broadleaf trees that develop a dense summer canopy creating a lower layer of shrubs and small trees (Bailey 1976). Soils consist of light-colored podzolic soils associated with forested regions

TABLE 3.3-5

Single Family/Multifamily Residential Data
Derry, NH

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	2,593	87	2,256	13	337	10,372	87	9,024	13	1,348

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	28,383	1,535	906	29,626,175	8,228,799	68	32	113,531	1,535	906	119,000,000	32,914,908

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-4.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-4.

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TABLE 3.3-6

Land Values
Derry, NH

Development Category	Range	Average Cost per Acre
Residential	Low	$ 13,000
	Medium	18,000
	High	20,000
Commercial	Low	20,000
	Medium	NA[a]
	High	90,000
Institutional	Low	1,000-5,000
	Medium	NA
	High	20,000

Source: Piper 1981.

[a]Not available.

(Strahler 1969). The reported 1980 population is 95,000, and the land area is 21 square miles (Kramer 1981).

3.3.2.2.2 Land Use/Land Availability

Land-use characteristics of the Brockton area are shown in Figure B-2 of Appendix B. Outlying residential (11) and commercial (12) areas are evident to the west and south of Brockton proper. Deciduous forestland (41) occupies most of the land surrounding Brockton.

Brockton is the fourth largest growth center in the Northeast and one of the few cities in Massachusetts showing positive growth trends. This is due to Brockton's relatively affordable housing and to excellent transportation access to Boston (Kramer 1981).

Table 3.3-7 contains the land-use/land-availability information for Brockton. Only 22 percent of the city's total land area is undeveloped. Kramer reports that most development involves scattered site infill-type projects. Total PSL is between 2,926 and 3,125 acres of which less than 700 acres might be available on undeveloped land.

Table 3.3-8 contains the single family/multifamily residential data for Brockton. A total of 5,693 acres is estimated for single family development and 851 acres for multifamily development. It also is speculated that a combined developed/undeveloped total of 42.1 million square feet of single family units and 17.9 million square feet of multifamily housing could exist in Brockton.

3.3.2.2.3 Land Values

Undeveloped land is not readily available in Brockton (O'Flaherty 1981). Table 3.3-9 presents land values for Brockton. Although a 10,000-square foot vacant lot may be available for as low as $3,000, the per acre cost of undeveloped land ranges between $12,900 and $46,400. Values for commercial and institutional property range between $30,000 and $90,000 per acre.

TABLE 3.3-7

Land Use/Land Availability
Brockton, MA

Development Category	(1) Total Acres	Developed Acres: (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres: (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	6,544	5,081	32-35	1,623-1,778	1,463	32-35	468-512
Commercial	1,115	866	34	294	249	34	85
Institutional	1,341	1,041	34	354	300	34	102
Other (MLU)	4,677	3,631	--	--	1,046	--	--
Total (city)	13,677	10,619	--	2,271-2,426	3,058	--	655-699

Development Category	Prescribed Density: (8) Low Minimum Lot Size (ft^2)	(8) Low Acres	(9) High Minimum Lot Size (ft^2)	(9) High Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land: (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land: (12) Low (units)[c]	(13) High (units)[d]
Residential	30,000	689	4,000	.092	7,374	55,282	2,123	15,902
Commercial[e]	10,000	.230	5,000	.115	3,765	7,530	1,083	2,165
Institutional[f]	10,000	.230	5,000	.115	4,526	9,052	1,304	2,609

Source: Kramer 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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TABLE 3.3-8

Single Family/Multifamily Residential Data
Brockton, MA

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	5,081	87	4,420	13	661	1,463	87	1,273	13	190

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	31,328	1,535	906	32,700,166	15,388,314	68	32	9,013	1,535	906	9,407,769	2,613,049

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-7.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-7.

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TABLE 3.3-9

Land Values
Brockton, MA

Development Category	Range	Average Cost per Acre
Residential	Low	$12,900
	Medium	32,000
	High	46,400
Commercial	Low	30,000
	Medium	65,000
	High	90,000
Institutional	Low	30,000
	Medium	65,000
	High	90,000

Source: O'Flaherty 1981.

3.3.2.3 Wilkes-Barre, Pennsylvania

3.3.2.3.1 Geography

Wilkes-Barre is located in northeastern Pennsylvania and is the home of two small colleges (Wilkes and Kings, enrollment 4,000 each). It also has historically been a mining town associated with anthracite coal and heavy industry. It is located in the Appalachian Highlands physiographic division, the Valley and Ridge province, the Middle section. The area is characterized by even-crested ridges predominating over valleys (Fenneman 1946). The city is about 500 to 600 feet msl and is divided by the Susquehanna River. Wilkes-Barre is in northern Hardwoods Forest section, and vegetation consists of transitional species including mixed stands of conifers and deciduous trees or completely separate stands of deciduous or coniferous forest depending on soil conditions (Bailey 1976). Soils in the area are light-colored podzolized soils of forested regions (Strahler 1969). The reported 1980 population is 51,117, and the land area is 7.6 square miles (Kutney 1981).

3.3.2.3.2 Land Use/Land Availability

As indicated in Figure B-3 of Appendix B, land east and southeast of Wilkes-Barre is primarily dedicated to deciduous forestland (41). Much of the land to the northwest shows extensive mining activities (75). Heavy urbanization (category 1) is noted in the Susquehanna River valley from the lower left portion of the map to the upper right (Scranton area).

Wilkes-Barre is very representative of northeastern Pennsylvania coal counties since it has been losing population for several decades. The city is trying to diversify its industrial base by attracting new industry and assisting smaller industries to remain and stabilize. The city is supportive of rehabilitation, historical preservation, and other efforts that support its image as the "newest old city in America" (Kutney 1981).

As shown in Table 3.3-10, 90 percent of Wilkes-Barre is developed land, mostly for residential uses. Total PSL in Wilkes-Barre is between 1,440 and 1,530 acres, of which less than 200 acres is on undeveloped land.

Table 3.3-11 contains the single family/multifamily residential data. Total single family land is estimated at 2,625 acres and multifamily at 392 acres. A total of 47.9 million square feet of single family uses and 13.3 million square feet of multifamily uses are estimated for the Wilkes-Barre area, most of which occurs for developed land.

3.3.2.3.3.1 Land Values

Land-cost information for Wilkes-Barre is found in Table 3.3-12. Undeveloped residential land ranges between $3,049 and $42,688 per acre. The lower cost range for commercial and institutional land is $42,688 per acre. Most of the parcels of vacant and developable land in Wilkes-Barre are available through the redevelopment authority. This is due to the significant amount of redevelopment necessitated by the 1972 flood in the city (Hutter 1981).

3.3.2.4 Regional Summary of Cities

Figure C-2 of Appendix C compares PSL availability of the three cities. Overall, Derry appears to have the potential for the most land, especially for undeveloped residential and institutional uses. Over 5,000 acres of PSL is available in undeveloped areas for these three cities with Derry having over 80 percent of what is available.

Figure D-2 of Appendix D compares land values for the three cities. Land costs in the area are not excessive. In examining Figures C-2 and D-2, it is apparent that PSL might be readily available and relatively inexpensive in the Derry area.

TABLE 3.3-10

Land Use/Land Availability
Wilkes-Barre, PA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	3,017	2,715	32-35	869-950	302	32-35	97-106
Commercial	716	644	34	219	72	34	25
Institutional	676	608	34	207	68	34	23
Other (MLU)	738	665	--	--	73	--	--
Total (city)	5,147	4,632	--	1,295-1,376	515	--	145-154

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft²)	Acres	(9) High Minimum Lot Size (ft²)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	5,000	.115	2,000	.046	23,609	59,022	2,626	6,565
Commercial[e]	10,000	.230	5,000	.115	2,800	5,600	313	626
Institutional[f]	10,000	.230	5,000	.115	2,643	5,287	296	591

Source: Kutney 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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TABLE 3.3-11

Single Family/Multifamily Residential Data
Wilkes-Barre, PA

Development Category	Developed Land					Undeveloped Land				
	Total Acres	Single Family		Multifamily		Total Acres	Single Family		Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	2,715	87	2,362	13	353	302	87	263	13	39

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	41,316	1,535	906	43,125,641	11,978,335	68	32	4,596	1,535	906	4,797,305	1,332,472

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-10.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-10.

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TABLE 3.3-12

Land Values
Wilkes Barre, PA

Development Category	Range	Average Cost per Acre
Residential	Low	$ 3,049
	Medium	30,056
	High	42,688
Commercial	Low	42,688
	Medium	74,923
	High	144,619
Institutional	Low	42,688
	Medium	NA[a]
	High	54,450

Source: Hutter 1981.

[a]Not available.

3.3.3 BLACK HILLS REGION

As previously defined, the Black Hills region is comprised of the states of Montana, Nebraska, North Dakota, South Dakota, and Wyoming. The cities selected for study in this region include Pierre, South Dakota (low density); Bozeman, Montana (medium density); and Omaha, Nebraska (high density). Figure 3.3-3 delineates the Black Hills region and locates the case study cities and additional reference cities. The following discussion evaluates the general geographic characteristics of each city, land use/availability, and land values.

3.3.3.1 Pierre, South Dakota

3.3.3.1.1 Geography

Pierre, the capital city, is located in central South Dakota. It is located in the Interior Plains physiographic division, the Great Plains province, Missouri Plateau (glaciated) section. The area is characterized by glaciated old plateaus and isolated mountains (Fenneman 1946). It is about 1,750 feet msl and is located on the east bank of the Missouri River. Ecologically, Pierre is in the Wheatgrass-Needlegrass section. Vegetation consists of short grass and shrubs, and soils are generally characterized as chestnut, dark-colored soils of the semiarid, subhumid, and humid grasslands (Bailey 1976). The reported 1980 population for Pierre is 11,996, and the land area covered is 11 square miles (Goehring 1981).

3.3.3.1.2 Land Use/Land Availability

Table 3.3-13 presents land-use/land-availability data for the city of Pierre. Although Pierre is the capital of South Dakota, less than 3 percent of its developed land is involved in institutional uses (67 acres). According to Mary Lu Goehring, administrative assistant in the city's Division of Public Works, Pierre is located in an agricultural area and does not have a strong commercial/industrial base. Approximately 50 percent of the total land area is in agricultural uses. Within the developed areas,

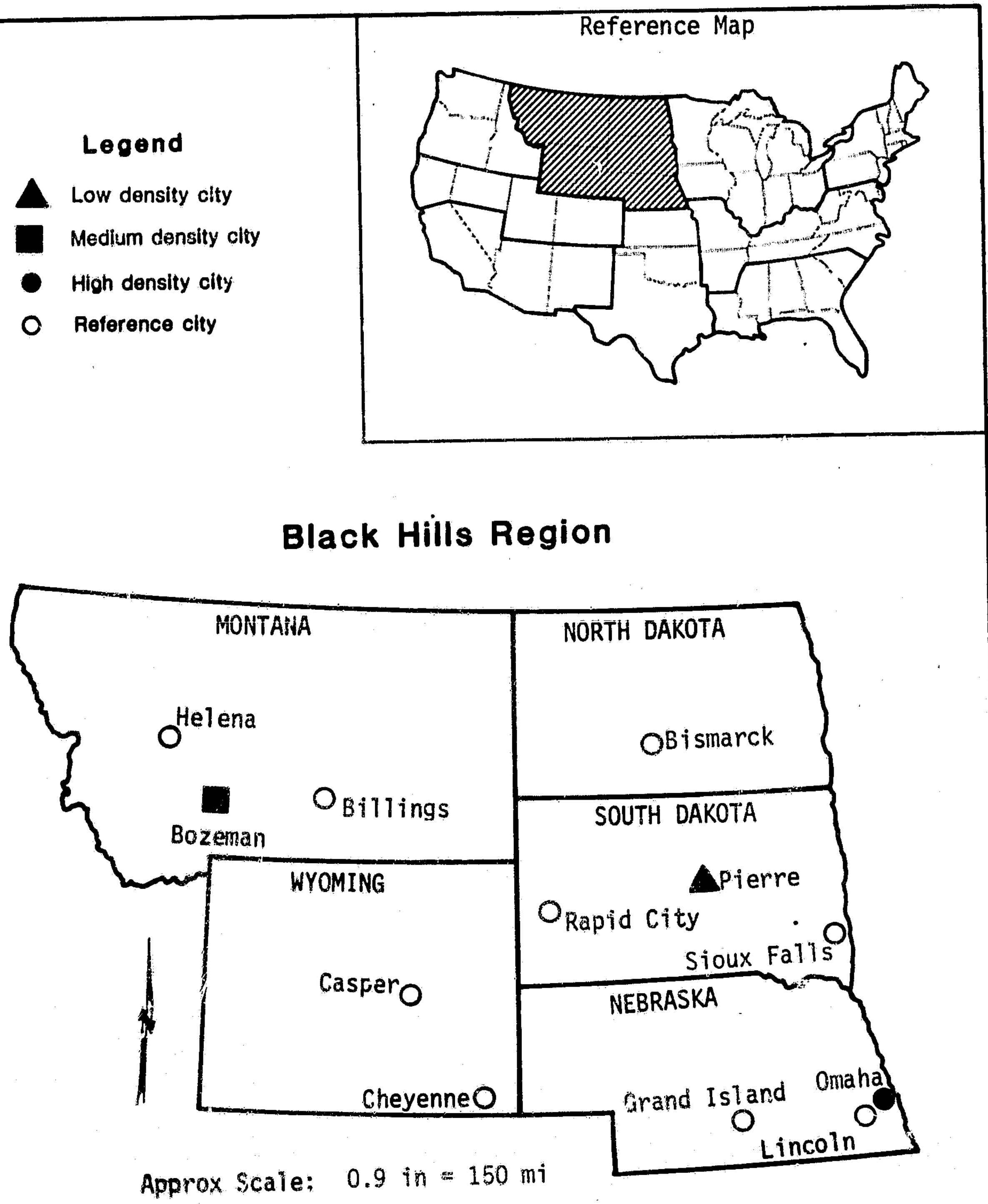

FIGURE 3.3-3

Location of Case Study Cities,
Black Hills Region

TABLE 3.3-13

Land Use/Land Availability
Pierre, SD

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	1,170	449	26-39	117-175	721	26-39	187-281
Commercial	878	337	34	115	541	34	181
Institutional	174	67	34	23	107	34	36
Other (MLU)	5,906	2,267	--	--	3,639	--	--
Total (city)	8,128	3,120	--	255-313	5,008	--	407-501

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft²)	Acres	(9) High Minimum Lot Size (ft²)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	8,500	.195	700	.016	2,303	28,063	3,697	45,063
Commercial[e]	6,000	.138	6,000	.138	2,442	2,442	3,920	3,920
Institutional[f]	6,000	.138	6,000	.138	1,261	1,261	775	775

Source: Goehring 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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approximately 26 to 39 percent is considered open space. Nonetheless, the city has shown steady growth since the 1970 census.

If Pierre can maintain its agricultural land-preservation policy, the maximum estimate for new residential units in the city is between 3,697 and 45,063 units. One also could expect 3,920 parcels developing with new commercial units and 775 parcels dedicated to new institutional uses. Total PSL for residential, commercial, and institutional uses ranges between 662 and 814 acres.

Table 3.3-14 shows the single family/multifamily residential data for Pierre. It is estimated that 1,018 acres are for single family development and 152 acres are for multifamily development. In combining developed and undeveloped lands, it is speculated that 41.2 million square feet of single family development and 11.5 million square feet of multifamily uses coud be available.

3.3.3.1.3 Land Values

Table 3.3-15 contains land-value information for Pierre. The range in land value for residential property is $33,750 to $73,750 while the range for commercial and institutional land is between $108,900 and $304,920. Although information for agricultural land was not available, it could be assumed to be significantly less in price and could be available for less than $10,000 per acre.

3.3.3.2 Bozeman, Montana

3.3.3.2.1 Geography

Bozeman is located in southwestern Montana (between the Bridger and Gallatin mountain ranges) and is the home of Montana State University. It is located in the Rocky Mountain System physiographic division, the Northern Rocky Mountains province. The area is characterized by deeply dissected mountain uplands and intermontane basins (Fenneman 1976). Bozeman has an elevation of 4,900 feet msl and is located near the Gallatin River. Ecologically,

TABLE 3.3-14

Single Family/Multifamily Residential Data
Pierre, SD

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	449	87	391	13	58	721	87	627	13	94

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	15,183	1,535	906	15,848,015	4,401,855	68	32	24,380	1,535	906	25,447,844	7,068,250

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-13.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-13.

TABLE 3.3-15

Land Values
Pierre, SD

Development Category	Range	Average Cost per Acre
Residential	Low	$ 33,750
	Medium	48,750
	High	73,750
Commercial	Low	108,900
	Medium	217,800
	High	304,920
Institutional	Low	108,900
	Medium	217,800
	High	304,920

Source: Barge 1981.

Bozeman is in the Douglas Fir Forest section. Natural vegetation consists of herbaceous rangeland, and soils are generally characterized as chestnut (Bailey 1976). The reported 1980 population for Bozeman is 21,645, and the land area covered is about 8 square miles (Bolton 1981).

3.3.3.2.2 Land Use/Land Availability

Figure B-4 of Appendix B presents land-use patterns in the Bozeman area. As shown, most of the area is dominated by cropland (21) and residential development (11). Note the isolated residential areas in the lower half of the rectangular area.

Bozeman is experiencing population growth. Paul Bolton, planning director, city of Bozeman, indicates that the population has increased significantly since 1975. Over the past 2 years, Bozeman has annexed an additional 1,300 acres of land.

To accommodate expected population development, the city is upgrading the existing wastewater treatment plant to eventually serve a population of 40,000. The city is acquiring water rights since water availability is a major development issue in this region. Although Bozeman is not in the "overthrust belt" energy development area, it is a regional center within Montana and has the most modern airport in the state.

Table 3.3-16 presents the land-use/land-availability information for Bozeman. The data reveal that approximately 46 percent (2,300 acres) of the city's land area is currently undeveloped or vacant land. The vacant land is expected to develop in predominantly residential-type uses (1,058 acres). Within subdivisions, land is set aside for park development. In most subdivisions this set-aside land is not developed unless residents choose to do so. This land could be utilized for retrofit purposes in existing development or in the future development of solar ponds (Bolton 1981).

If Bozeman develops at the maximum density permitted by its zoning ordinance, 1,058 to 16,531 new residential units can be expected. An additional 1,400 commercial units and 3,800 institutional units (assuming a

TABLE 3.3-16

Land Use/Land Availability
Bozeman, MT

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	2,300	1,242	26-39	322-484	1,058	26-39	275-413
Commercial	350	189	34	64	161	34	55
Institutional	950	513	34	323	437	34	149
Other (MLU)	1,400	752	--	--	644	--	--
Total (city)	5,000	2,700	--	709-871	2,300	--	479-617

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	43,560	1.0	2,800	.064	1,242	19,406	1,058	16,531
Commercial[e]	5,000	.115	5,000	.115	1,643	1,643	1,400	1,400
Institutional[f]	5,000	.115	5,000	.115	4,461	4,461	3,800	3,800

Source: Bolton 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

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5,000-square foot minimum lot size) could theoretically develop as well. The estimate for total PSL in Bozeman is 1,188 to 1,488 acres.

The single family/multifamily residential information for Bozeman is found in Table 3.3-17. The calculated breakdown for total residential land is 2,002 acres of single family uses and 298 acres of multifamily use. An estimated 19.9 million square feet of single family space and 5.5 million square feet of multifamily space is potentially available in Bozeman with slightly less than half of those estimates being undeveloped land.

3.3.3.2.3 Land Values

Table 3.3-18 contains data regarding average land values for Bozeman. The value for residential land is surprisingly high with a range of $74,050 to $104,544 per acre. The range for commercial land is $174,240 to $239,910. The information obtained for institutional land shows a range of $12,000 to $16,000 (with urban services) and probably more closely approximates the cost of undeveloped land in Bozeman.

3.3.3.3 Omaha, Nebraska

3.3.3.3.1 Geography

Omaha is located in southeastern Nebraska on the Nebraska-Iowa border (Missouri River) and is the home of the University of Nebraska at Omaha and Creighton University. It is located in the Interior Plains physiographic division, Central Lowland province, Dissected Till Plains section (Fenneman 1946). Omaha is at an elevation of about 1,050 msl and is located on the western bank of the Missouri River. Ecologically, Omaha is in the Bluestem-Prairie section. Vegetation is characterized by tallgrass, parklands, and mixed grasslands, and soils are generally characterized as prairie (Bailey 1976). The reported 1980 population is 315,000, and the 1980 land area consisted of 92.5 square miles (Kubovec 1981).

TABLE 3.3-17

Single Family/Multifamily Residential Data
Bozeman, MT

Development Category	Developed Land					Undeveloped Land				
	Total Acres	Single Family		Multifamily		Total Acres	Single Family		Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	1,242	87	1,081	13	161	1,058	87	921	13	137

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	10,324	1,535	906	10,776,191	2,993,134	68	32	8,796	1,535	906	9,181,265	2,550,136

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-16.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-16.

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TABLE 3.3-18

Land Values
Bozeman, MT

Development Category	Range	Average Cost per Acre
Residential	Low	$ 74,052
	Medium	80,586
	High	104,544
Commercial	Low	174,240
	Medium	207,076
	High	239,910
Institutional[a]	Low	12,000
	Medium	14,300
	High	16,600

Source: Shine 1981.

[a]Assuming a 5-acre site with urban services.

3.3.3.3.2 Land Use/Land Availability

The city of Omaha has a comprehensive growth management policy that focuses on the timing, sequencing, and overall direction of suburban growth; encourages inner-city redevelopment and rehabilitation; and seeks to preserve prime agricultural lands. Omaha has extraterritorial jurisdiction over an approximate 150-square mile area for zoning and subdivision regulation. Omaha will be pursuing an aggressive annexation program over the next few years (Kubovec 1981).

Table 3.3-19 contains the land-use/land-availability data for the city of Omaha. The estimated maximum for additional residential units is between 25,405 and 389,556. For additional commercial units, the range is between 1,275 and 1,530. Additional institutional uses show a maximum of 10,942 and 13,130 additional units. Total PSL in Omaha is between 8,734 and 11,414 acres.

Information on single family/multifamily residential breakdowns is found in Table 3.3-20. It is estimated that there are potentially 17,943 acres of single family uses and 2,681 acres of multifamily uses, most of which are already developed. A total of 1.3 billion square feet of single family units and 355 million square feet of multifamily units are estimated to potentially exist in Omaha. Of these totals, about 17 percent are on undeveloped land.

3.3.3.3.3 Land Values

Land values for Omaha are presented in Table 3.3-21. The cost of raw agricultural land without urban services is about $2,000 per acre. Residential land, however, ranges in price from $28,000 to $37,500 per acre while commercial and institutional land costs range from $108,900 to $435,600 per acre. The significant difference between agricultural land and developed land is most likely a function of obtaining proper zoning and subdivision approval for a site that may be in conflict with the city's urban development (i.e., agricultural land preservation) policy.

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TABLE 3.3-19

Land Use/Land Availability
Omaha, NB

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	20,624	17,188	26-39	4,451-6,676	3,506	26-39	912-1,367
Commercial	1,036	860	34	292	176	34	60
Institutional	8,880	7,370	34	2,506	1,510	34	513
Other (MLU)	28,660	23,788	--	--	4,872	--	--
Total (city)	59,200	49,136	--	7,249-9,474	10,064	--	1,485-1,940

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	6,000	.138	400	.009	124,550	1,909,778	25,405	389,556
Commercial[e]	6,000	.138	5,000	.115	6,232	7,478	1,275	1,530
Institutional[f]	6,000	.138	5,000	.115	53,406	64,087	10,942	13,130

Source: Kubovec 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-20

Single Family/Multifamily Residential Data
Omaha, NB

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	17,118	87	14,893	13	2,225	3,506	87	3,050	13	456

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	1,017,164	1,535	906	1,061,715,783	294,896,187	68	32	207,481	1,535	906	216,568,668	60,152,892

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-19.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-19.

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TABLE 3.3-21

Land Values
Omaha, NB

Development Category	Range	Average Cost[a] per Acre
Residential	Low	$ 28,000
	Medium	32,750
	High	37,500
Commercial	Low	108,900
	Medium	174,240
	High	435,600
Institutional	Low	108,900
	Medium	174,240
	High	435,600

Source: Strong 1981.

[a]Agricultural land (raw land without urban services) is available for approximately $2,000 per acre.

3.3.3.4 Regional Summary of Cities

Figure C-3 of Appendix C compares land availability in the Black Hills region. As shown, Omaha has over 6 times more land area than either Pierre or Bozeman and has more PSL available in undeveloped areas, primarily residential and institutional. Note that Pierre has almost 200 acres of commercial PSL, over three times as much as Bozeman or Omaha. The three cities combined have over 3,000 acres of currently undeveloped PSL.

Figure D-3 of Appendix D presents land-value comparisons for the three cities. Residential land is less expensive in Omaha and Pierre, commercial costs are similar in all three cities, and institutional land is relatively inexpensive in Bozeman. There appears to be over 125 acres of institutional PSL available in Bozeman for a reasonable price.

3.3.4 GREAT LAKES REGION

Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin are the states that make up the Great Lakes region. The cities selected for study in this region include Oregon, Ohio (low density); Madison, Wisconsin (medium density); and Euclid, Ohio (high density). Figure 3.3-4 delineates the Great Lakes region and locates the case study cities and additional reference cities. General geographic characteristics, land use/availability, and land values of each city are evaluated in the following discussion.

3.3.4.1. Oregon, Ohio

3.3.4.1.1 Geography

Oregon is located in northwestern Ohio, is a suburb of Toledo, and is at the mouth of the Maumee River on the shore of Lake Erie. It is located in the Interior Plains physiographic division, Central Lowland province, Eastern Lake section and is characterized by maturely dissected and glaciated cuestas and lowlands, moraines, lacustrine plains, and lakes (Fenneman 1946). It lies at elevation 600 msl and is relatively flat with open

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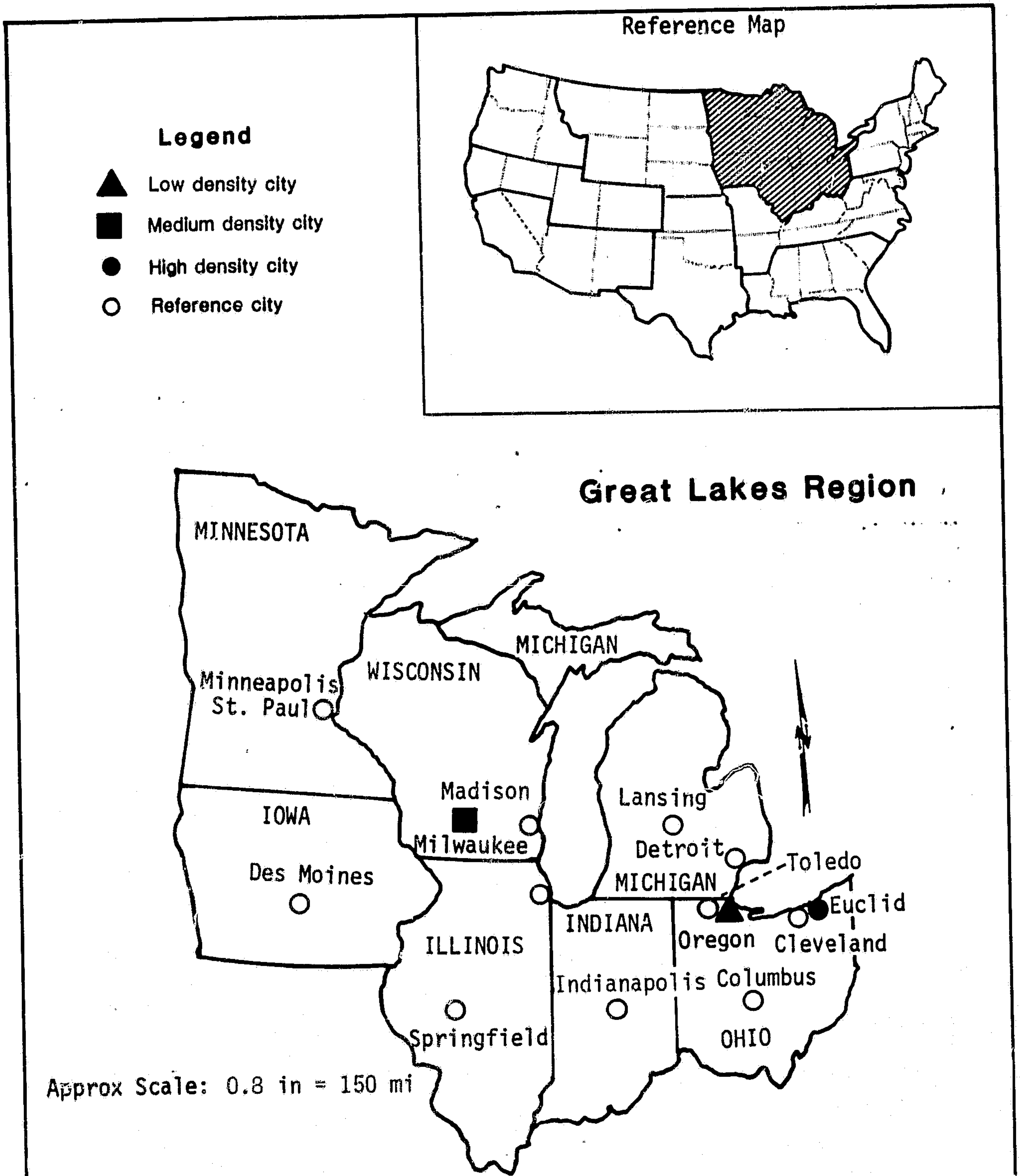

FIGURE 3.3-4

Location of Case Study Cities,
Great Lakes Region

country. Ecologically, Oregon is found in the Beech-Maple Forest section where natural vegetation is dominated by tall, broadleaf trees forming a canopy with smaller trees and shrubs underneath (Bailey 1976). Successional patterns will climax in a beech-maple forest. Soils are considered as "meadow soils" and are typical of marshes, bogs, swamps, and flat uplands (Strahler 1969). The reported 1980 population for Oregon is 18,500, and the land area is 28.4 square miles (Surface 1981).

3.3.4.1.2 Land Use/Land Availability

Land use in the city of Oregon displays an industrial character (13) that complements the residential (11) and commercial (12) uses, as indicated in Figure B-5 of Appendix B. The development patterns of suburban Toledo are noted to the northwest, west, and southeast of Oregon, and Lake Erie is to the northeast (52 and 54). Outlying residential and commercial districts are evident to the east and south and are predominantly surrounded by large tracts of cropland and pastures (21).

Table 3.3-22 presents the land-use/land-availability information for Oregon. The city has an almost classic land-use breakdown with 34 percent of its land in residential, 4 percent in commercial, and 2 percent in institutional uses. Total PSL is estimated from 1,649 to 2,158 acres. The estimate for additional units ranges between 3,893 and 31,351 residential units, 3,228 commercial units, and 2,158 institutional units.

Table 3.3-23 contains the single family/multifamily residential data for Oregon. The ratio for single family to multifamily land uses is 5,536 acres to 827 acres. An estimated 65.5 million square feet of single family dwelling space and 18.1 million square feet of multifamily dwelling space are potentially available in the Oregon area. About 29 percent of this potential space is available in the undeveloped areas.

3.3.4.1.3 Land Values

Table 3.3-24 shows land values for the Oregon area. Undeveloped property is available for as low as $2,000 per acre in all three categories. The wide

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TABLE 3.3-22

Land Use/Land Availability
Oregon, OH

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	6,363	4,576	20-28	915-1,281	1,787	20-28	357-500
Commercial	664	480	34	163	184	34	63
Institutional	443	320	34	109	123	34	42
Other (MLU)	10,770	7,744	--	--	3,026	--	--
Total (city)	18,240	13,120	--	1,187-1,553	5,120	--	462-605

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	20,000	.459	2,500	.057	9,969	80,281	3,893	31,351
Commercial[e]	2,500	.057	2,500	.057	8,421	8,421	3,228	3,228
Institutional[f]	2,500	.057	2,500	.057	5,614	5,614	2,158	2,158

Source: Surface 1981.

[a] Data in column 2 divided by data in column 8.
[b] Data in column 2 divided by data in column 9.
[c] Data in column 5 divided by data in column 8.
[d] Data in column 5 divided by data in column 9.
[e] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f] Assume minimum lot sizes are the same as commercial.

TABLE 3.3-23

Single Family/Multifamily Residential Data
Oregon, OH

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	4,576	87	3,981	13	595	1,787	87	1,555	13	232

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	45,125	1,535	906	47,101,475	13,082,640	68	32	17,622	1,535	906	18,393,844	5,108,970

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-22.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-22.

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TABLE 3.3-24

Land Values
Oregon, OH

Development Category	Range	Average Cost per Acre
Residential	Low	$ 2,000
	Medium	10,000
	High	150,000
Commercial	Low	2,000
	Medium	76,000
	High	150,000
Institutional	Low	2,000
	Medium	76,000
	High	150,000

Source: Mohan 1981.

variation between the low values and the high values may represent the difference between developed and undeveloped property.

3.3.4.2 Madison, Wisconsin

3.3.4.2.1 Geography

Madison, the capital city, is located in south-central Wisconsin and is the home of the main campus of the University of Wisconsin. Similarly to Oregon, Ohio, it is located in the Eastern Lake physiographic section and is very close to the Driftless Area section. It is at elevation 850 to 900 feet msl, is situated between two lakes, Lake Mendota and Lake Monona, and is characterized by flat to rolling terrain. Ecologically, it is in the Maple-Basswood Forest section, which is in the same province (Eastern Deciduous) as Oregon, Ohio, and exhibits similar characteristics. Approximately 30 percent of the area is forested (Patterson 1981). Soils are characterized as gray-brown podzolic, typical of forested regions (Strahler 1969). The reported 1980 population is 178,000, and the land area is 52 square miles (Peterson 1981).

3.3.4.2.2 Land Use/Land Availability

As previously acknowledged, Madison is located between two lakes, Mendota and Monona. The urban area exhibits concentrated residential (11) and commercial (12) development between and northeast of the lakes, and south of Lake Mendota, as shown in Figure B-6 of Appendix B. Much of the area surrounding Madison has been cleared and is dedicated to cropland and pastures (21).

According to Table 3.3-25 about 30 percent of Madison's total land is undeveloped. Pond-suitable land ranges from 21 to 26 percent of the total land area (7,103 to 8,586 acres). For undeveloped land, estimates range from 40,304 to 120,913 new units for residential property, from 9,304 to 27,913 new units for commercial property, and from 12,399 to 37,196 new units for institutional property.

TABLE 3.3-25

Land Use/Land Availability
Madison, WI

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	18,541	12,979	20-28	2,596-3,634	5,562	20-28	1,112-1,557
Commercial	4,279	2,995	34	1,018	1,284	34	437
Institutional	5,705	3,994	34	1,358	1,711	34	582
Other (MLU)	4,755	3,328	--	--	1,427	--	--
Total (city)	33,280	23,296	--	4,972-6,010	9,984	--	2,131-2,576

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	6,000	.138	2,000	.046	94,050	282,152	40,304	120,913
Commercial[e]	6,000	.138	2,000	.046	21,703	21,703	9,304	27,913
Institutional[f]	6,000	.138	2,000	.046	28,942	28,942	12,399	37,196

Source: Peterson 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

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Table 3.3-26 contains the single family/multifamily residential data for Madison. The ratio of single family to multifamily land uses is 16,131 acres to 2,410 acres. A total of 280.4 million square feet of single family space and 77.8 million square feet of multifamily space is potentially available. About 30 percent of these square footage data are potentially available in undeveloped land.

3.3.4.2.3 Land Values

Table 3.3-27 presents land values for Madison. The land values in Madison probably represent prices for developed residential property ($45,000 to $75,000). The values for commercial and institutional properties are relatively low ($13,068), for a 10 to 15-acre tract.

3.3.4.3 Euclid, Ohio

3.3.4.3.1 Geography

Euclid is located in northeastern Ohio on the shores of Lake Erie and is a suburb of Cleveland. Physiographically, it is located on the border that divides the Appalachian Plateau and the Central Lowland divisions and, more specifically, the New York section and the Eastern Lakes section (Fenneman 1946). It is about 650-750 feet msl and is characterized by flat to hilly terrain. Ecological characteristics are very similar to Oregon, Ohio. Soils are classified as gray-brown podzolic (Strahler 1969). The reported 1980 population for Euclid is 59,999, and the land area is 10.3 square miles (Hoag 1981).

3.3.4.3.2 Land Use/Land Availability

Euclid is part of a heavily urbanized complex in the Cleveland area, as identified in Figure B-7 of Appendix B. Urban development (category 1) is dense in the adjacent areas to the northeast, southeast, and south-southwest. Lake Erie forms the northwestern border. Cropland and pastureland (21) and deciduous forestland (41) are conspicuous to the east and are interspersed among the sporadically developed areas.

TABLE 3.3-26

Single Family/Multifamily Residential Data
Madison, WI

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	12,979	87	11,292	13	1,687	5,562	87	4,839	13	723

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	188,101	1,535	906	196,340,000	54,534,242	68	32	80,609	1,535	906	84,139,674	23,370,161

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-25.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-25.

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TABLE 3.3-27

Land Values
Madison, WI

Development Category	Range	Average Cost per Acre
Residential	Low	$ 45,000
	Medium	55,000
	High	75,000
Commercial[a]	Low	13,068
	Medium	39,204
	High	76,230
Institutional[a]	Low	13,068
	Medium	39,204
	High	76,230

Source: Hart 1981.

[a]Values shown are for a 10 to 15-acre tract of land.

Euclid was the site of a seminal supreme court decision validating the right of a city to impose zoning. Currently, Euclid reflects the national economy and is maintaining a status quo. As presented in Table 3.3-28, the city is 89 percent developed. Total available PSL ranges from 733 to 905 acres. The city has indicated that there are several acres of retention ponds that could be converted to solar pond use (Hoag 1981). The zoning code permits a combined (developed and undeveloped) maximum development of 37,533 to 215,813 residential units, 5,007 commercial units, and 8,674 institutional units.

The ratio of single family to multifamily land use is 3,004 acres to 449 acres, as depicted in Table 3.3-29. This acreage potentially lends itself to 195 million square feet of single family space and 115 million square feet of multifamily space. Approximately 11 percent of these square footage totals are potentially committed to undeveloped lands.

3.3.4.3.3 Land Values

As Table 3.3-30 indicates, land values in Euclid are relatively high. Individual residential lots with services cost from $8,000 to $20,000 per 7,500-square foot lot creating a total land cost of $46,400 to $116,000 per acre. Undeveloped commercial and institutional property costs about $40,000 per acre. Land values in Euclid are relatively stable, partly due to a slow real estate market as well as to a general scarcity of large tracts of undeveloped land.

3.3.4.4 Regional Summary of Cities

Figure C-4 of Appendix C compares the PSL available in the Great Lakes region. Madison exhibits the largest land area (35,000 acres) and also the most potential PSL (9,000 acres). Oregon and Euclid reflect only minimal amounts of PSL. Within the undeveloped sector, Madison reflects over 2,500 acres of PSL, over 60 percent of which is in the residential category. The three cities combined have about 4,000 acres of undeveloped PSL.

C-2

TABLE 3.3-28

Land Use/Land Availability
Euclid, OH

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	3,453	3,062	15-20	459-612	391	15-20	58-78
Commercial	234	208	34	71	26	34	9
Institutional	399	354	34	120	45	34	15
Other (MLU)	2,580	2,288	--	--	292	--	--
Total (city)	6,666	5,912	--	650-803	754	--	83-102

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft²)	Acres	(9) High Minimum Lot Size (ft²)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	4,000	.092	700	.016	33,283	191,375	4,250	24,438
Commercial[e]	2,000	.046	2,000	.046	4,522	4,522	565	565
Institutional[f]	2,000	.046	2,000	.046	7,696	7,696	978	978

Source: Hoag 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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TABLE 3.3-29

Single Family/Multifamily Residential Data
Euclid, OH

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	3,062	87	2,664	13	398	391	87	340	13	51

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	112,229	1,535	906	172,720,431	101,679,474	68	32	14,344	1,535	906	22,018,040	12,995,664

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-28.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-28.

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TABLE 3.3-30

Land Values
Euclid, OH

Development Category	Range	Average Cost per Acre
Residential	Low	$ 46,400
	Medium	58,000
	High	116,000
Commercial	Low	NA[a]
	Medium	40,000
	High	NA
Institutional	Low	NA
	Medium	40,000
	High	NA

Source: Slechta 1981.

[a]Not available.

Figure D-4 of Appendix D graphically summarizes land values in the region. As shown, Oregon displays a wider range of costs than either Madison or Euclid. Low-range costs for all uses are the same in Oregon. In comparing figures C-4 and D-4, it appears that residential PSL in Oregon is potentially available at a low cost, whereas almost 600 acres of institutional land in Madison could be a good buy.

3.3.5 GULF COAST REGION

The Gulf Coast region encompasses the southeastern United States and includes Alabama, Florida, Georgia, Louisiana, Mississippi, and South Carolina. Case study cities for this region include Bainbridge, Georgia (low density); Birmingham, Alabama (medium density); and Baton Rouge, Louisiana (high density). Figure 3.3-5 presents the Gulf Coast region and locates the study cities and additional reference cities. Following is a discussion that describes the geography, land use/availability, and land values in each city.

3.3.5.1 Bainbridge, Georgia

3.3.5.1.1 Geography

Bainbridge is located in extreme southwestern Georgia and is the home of Bainbridge Junior College. It is located in the Atlantic Plain physiographic division, the Coastal Plain province, East Gulf Coastal Plain section, and is characterized by a young to mature belted coastal plain (Fenneman 1946). The city is at elevation 100 to 125 feet msl and is located on the Flint River at the upper end of the formation of Lake Seminole. The terrain is characterized as rolling. Southwestern Georgia is in the Beech-Sweetgum-Magnolia-Pine-Oak Forest section ecoregion. The vegetation is termed temperate rainforest, has moderate canopy density, and is primarily comprised of evergreen oaks, laurels, and magnolias. The understory vegetation includes tree ferns, small palms, shrubs, and herbaceous plants (Bailey 1976). Soils are classified as red-yellow podzolic and are characteristic of southern forests (Strahler 1969). The

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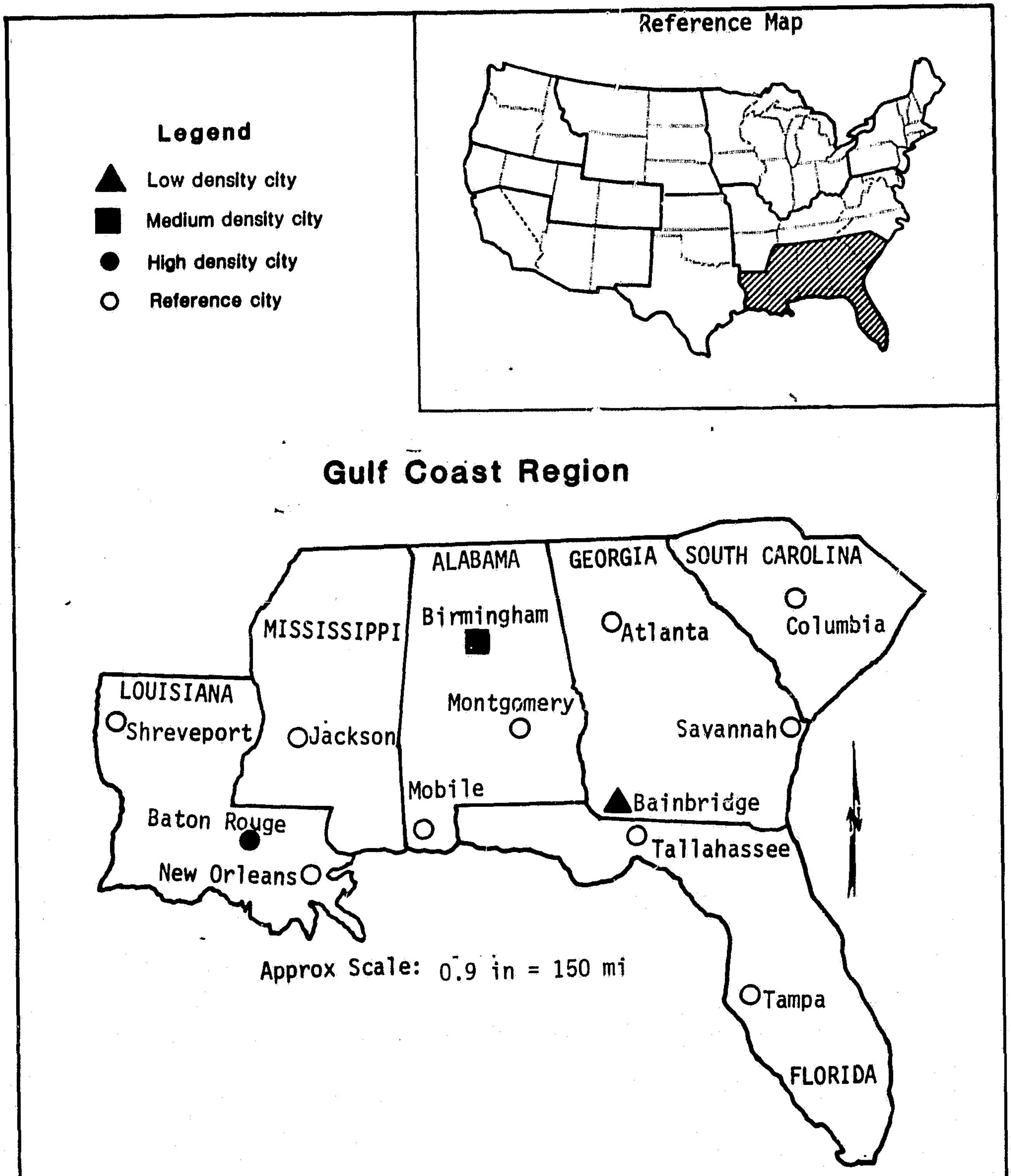

FIGURE 3.3-5

Location of Case Study Cities,
Gulf Coast Region

reported 1980 population for Bainbridge is 10,513, and the land area is 15 square miles (Aldrich 1981).

3.3.5.1.2 Land Use/Land Availability

Figure B-8 of Appendix B shows the land-use patterns in the Bainbridge area. Fringe urban development is evident in all directions. Evergreen forest-land (42) dominates the countryside, although there are isolated concentrations of cropland and pastureland (21).

Most of the population growth and development is taking place in Decatur County rather than the city of Bainbridge. As Table 3.3-31 indicates, about 20 percent of the total land area in Bainbridge is undeveloped land. Total PSL ranges from 2,463 to 2,585 acres or 25 to 27 percent of the total available land. For developed land the maximum number of units permitted under the existing zoning code for developed land is 1,522 units for institutional uses, 6,096 for commercial uses, and between 17,840 and 613,250 units for residential uses. Corresponding figures for undeveloped land include 383 additional units for institutional uses, 1,526 units for commercial uses, and 4,462 to 153,375 units for residential uses.

Table 3.3-32 shows that 412 million square feet of single family and 114 million square feet of multifamily space are theoretically available in Bainbridge. About 20 percent of this square footage is potentially available in the undeveloped section. These figures are based on a total residential ratio of 5,336 acres of single family uses to 797 acres of multifamily uses.

3.3.5.1.3 Land Values

Land values for the Bainbridge area are shown in Table 3.3-33. These prices are relatively inexpensive when compared with other cities. Institutional prices are lower than either residential or commercial costs.

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TABLE 3.3-31

Land Use/Land Availability
Bainbridge, GA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	6,133	4,906	28-30	1,374-1,472	1,227	28-30	344-368
Commercial	1,753	1,402	34	477	351	34	119
Institutional	438	350	34	119	88	34	30
Other (MLU)	1,276	1,022	--	--	254	--	--
Total (city)	9,600	7,680	--	1,970-2,068	1,920	--	493-517

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft²)	Acres	(9) High Minimum Lot Size (ft²)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	12,000	.275	350	.008	17,840	613,250	4,462	153,375
Commercial[e]	10,000	.230	10,000	.230	6,096	6,096	1,526	1,526
Institutional[f]	10,000	.230	10,000	.230	1,522	1,522	383	383

Source: Aldrich 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-32

Single Family/Multifamily Residential Data
Bainbridge, GA

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	4,906	87	4,268	13	638	1,227	87	1,068	13	159

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	315,545	1,535	906	329,370,000	91,482,806	68	32	78,919	1,535	906	82,375,652	22,880,196

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-31.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-31.

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TABLE 3.3-33

Land Values
Bainbridge, GA

Development Category	Range	Average Cost per Acre
Residential	Low	NA[a]
	Medium	$17,000
	High	NA
Commercial	Low	NA
	Medium	25,000
	High	NA
Institutional	Low	NA
	Medium	10,000
	High	NA

Source: Booker 1981.

[a]Not available.

3.3.5.2 Birmingham, Alabama

3.3.5.2.1 Geography

Birmingham is located in north-central Alabama and is the home of the University of Alabama at Birmingham and Birmingham Southern College. It is in the Appalachian Highland physiographic division, the Valley and Ridge province, Tennessee section, and is characterized by second-cycle mountains and valley belts that predominate over crested ridges (Fenneman 1946). Elevation is at 640 to 650 feet msl, and the topography is rolling to hilly. Vegetation is characteristic of the Southeastern Mixed Forest Province ecoregion and includes a climax pattern of medium to tall forests of broadleaf deciduous and needleleaf evergreen trees, 50 percent of which are pines (Bailey 1976). Approximately 60 percent of the city is forested (Moody 1981). Soil groupings include lithosols (shallow soils, sands, and lava beds) characteristic of mountainous regions (Strahler 1969). Birmingham had a reported 1980 population of 284,388 and a land area of 98 square miles (Moody 1981).

3.3.5.2.2 Land Use/Land Availability

Figure B-9 of Appendix B reveals a strip of cropland and pastureland (21) in the southwestern portion of Birmingham. This pattern is exhibited within the city proper and may offer some unique possibilities in relation to solar pond technology. Development on the urban fringe is extensive to the northeast and southwest but less dense and more sporadic to the northwest and southeast. Most of the countryside is covered with mixed forestland (43).

Birmingham has seen a change to an older population and a city that is becoming more racially polarized over the last 20 years. Growth has been declining within the city limits, and downtown revitalization to attract new business is a major redevelopment emphasis (Moody 1981).

Table 3.3-34 shows that 71 percent of the city's total land area is developed. Thirty percent of this developed land is committed to residential

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TABLE 3.3-34

Land Use/Land Availability
Birmingham, AL

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	26,464	18,879	28-30	5,286-5,664	7,585	28-30	2,124-2,276
Commercial	2,901	2,070	34	704	831	34	283
Institutional	7,034	5,018	34	1,076	2,016	34	685
Other (MLU)	26,321	18,777	--	--	7,544	--	--
Total (city)	62,720	44,744	--	7,066-7,444	17,976	--	3,092-3,244

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	15,000	.344	350	.008	54,881	2,359,875	22,049	948,125
Commercial[e]	2,500	.057	1,000	.023	36,316	90,000	14,579	36,130
Institutional[f]	2,500	.057	1,000	.023	88,035	218,174	35,368	87,652

Source: Moody 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

uses. There are an estimated 10,158 to 10,688 acres of PSL. The maximum number of units permitted under the zoning code includes 54,881 to 2,359,875 existing units and 22,049 to 948,125 additional residential units. The calculations for commercial property are 36,316 to 90,000 existing units and 14,579 to 36,130 additional units. For institutional land uses, the estimates are 88,035 to 218,179 existing units and 35,368 to 87,652 additional units.

Table 3.3-35 presents the information on single family/multifamily residential data for Birmingham. The ratio of single family land to multifamily land is 23,054 to 3,440 acres. Estimates show that about 1,767 million square feet of single family space and 491 million square feet of multifamily space are potentially available in the Birmingham area. Of these totals, about 29 percent of the calculated square footage is within the undeveloped land in the city.

3.3.5.2.3 Land Values

Table 3.3-36 presents land-value data for Birmingham. A sewer moratorium in effect for parts of the Birmingham area has created a soft residential real estate market (Chichester 1981). Undeveloped residential land is relatively affordable and ranges from $2,000 to $20,000 per acre. Commercial land is much higher, whereas institutional land prices could be considered moderate in Birmingham.

3.3.5.3 Baton Rouge, Louisiana

3.3.5.3.1 Geography

Baton Rouge is located in southeastern Louisiana and is the home of Louisiana State University and Southern University. It is in the Atlantic Plain physiographic division, Coastal Plain province, Mississippi Alluvial Plain section and is characterized by floodplain and delta (Fenneman 1946). Elevation is at 50 to 70 feet msl and there is minimal relief. The city is located on the east bank of the Mississippi River. Ecologically, Baton Rouge is in the Southern Floodplain Forest section, which is a subdivision

TABLE 3.3-35

Single Family/Multifamily Residential Data
Birmingham, AL

Development Category	Developed Land: Total Acres	Developed Land: Single Family Percent of Total	Developed Land: Single Family Calculated Acreage	Developed Land: Multifamily Percent of Total	Developed Land: Multifamily Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family Percent of Total	Undeveloped Land: Single Family Calculated Acreage	Undeveloped Land: Multifamily Percent of Total	Undeveloped Land: Multifamily Calculated Acreage
Residential	18,879	87	16,425	13	2,454	7,585	87	6,599	13	986

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	1,207,378	1,535	906	1,260,300,000	350,040,000	68	32	485,087	1,535	906	506,330,000	140,640,000

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-34.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-34.

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TABLE 3.3-36

Land Values
Birmingham, AL

Development Category	Range	Average Cost per Acre
Residential	Low	$ 2,000
	Medium	10,000
	High	20,000
Commercial	Low	21,780
	Medium	87,120
	High	217,800
Institutional	Low	NA[a]
	Medium	25,000[b]
	High	NA

Source: Chichester 1981.

[a]Not available.

[b]Value shown is for a 40-acre tract of land.

of the same province (Outer Coastal Plain Forest) in which Bainbridge, Georgia, is located. Approximately 85 percent of Baton Rouge is forested (Barker 1981). Soils are alluvial in nature and reflect the effects of the Mississippi River. Baton Rouge had a 1980 population of 219,486, and a land area of 63.9 square miles (Barker 1981).

3.3.5.3.2 Land Use/Land Availability

Baton Rouge has a growth rate of about 32 percent since 1970 largely due to an active annexation program. For example, the city annexation has included an additional 15,000 to 20,000 people since the 1980 census (Barker 1981).

Thirty-four percent of Baton Rouge's total land area is undeveloped as shown on Table 3.3-37. Total PSL is estimated between 6,243 and 6,512 acres. An additional 16,696 institutional units, 505 commercial units, and 28,683 to 200,783 residential units are the maximum number of units permitted for the undeveloped land.

Table 3.3-38 presents single family/multifamily residential data. The breakdown between single family and multifamily use is 7,769 acres to 1,748 acres, respectively. It is estimated that 349 million square feet and 97 million square feet are theoretically available for single family and multifamily uses, respectively. Of these totals, about 34 percent of the square footage is available within the undeveloped areas.

3.3.5.3.3 Land Values

Table 3.3-39 shows the land-value information for Baton Rouge. Land costs seem relatively low since residential values range from $7,000 to $22,000 per acre. Values for commercial property are between $20,000 to $60,000 per acre. Institutional property costs about 10 percent less than commercial property.

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TABLE 3.3-37

Land Use/Land Availability
Baton Rouge, LA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	13,448	8,830	28-30	2,472-2,649	4,618	28-30	1,293-1,385
Commercial	1,693	1,112	34	378	581	34	198
Institutional	5,592	3,672	34	1,249	1,920	34	653
Other (MLU)	12,443	8,171	--	--	4,272	--	--
Total (city)	33,176	21,785	--	4,099-4,276	11,391	--	2,144-2,236

Development Category	Prescribed Density (8) Low: Minimum Lot Size (ft^2)	Acres	(9) High: Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	7,000	.161	1,000	.023	54,845	383,913	28,683	200,783
Commercial[e]	5,000	.115	5,000	.115	9,670	9,670	505	505
Institutional[f]	5,000	.115	5,000	.115	31,930	31,930	16,696	16,696

Source: Barker 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-38

Single Family/Multifamily Residential Data
Baton Rouge, LA

Development Category	Developed Land					Undeveloped Land				
	Total Acres	Single Family		Multifamily		Total Acres	Single Family		Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	8,830	87	7,682	13	1,148	4,618	87	4,018	13	600

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	219,379	1,535	906	228,990,000	63,602,360	68	32	114,733	1,535	906	119,760,000	33,263,391

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-37.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-37.

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TABLE 3.3-39

Land Values
Baton Rouge, LA

Development Category	Range	Average Cost per Acre
Residential	Low	$ 7,000
	Medium	20,000
	High	22,000
Commercial	Low	20,000
	Medium	40,000
	High	60,000
Institutional	Low	18,000
	Medium	36,000
	High	54,000

Source: Barker 1981.

3.3.5.4 Regional Summary of Cities

Of the three regional cities, Birmingham displays the largest land area (over 60,000 acres), as shown in Figure C-5 of Appendix C. All three cities exhibit over 500 acres of undeveloped residential PSL. Bainbridge has the most available commercial PSL (over 350 acres), whereas Birmingham and Baton Rouge have over 600 acres of institutional land potentially available for solar pond development. In total, there are about 4,000 pond-suitable acres available for these three cities in the undeveloped categories.

Figure D-5 depicts land-value comparisons for the regional cities. Residential property in Birmingham is relatively inexpensive. Land prices in Bainbridge appear to be more reasonable overall. In general, Figures C-5 and D-5 indicate there is a lot of undeveloped PSL in Birmingham for a reasonable cost.

3.3.6 HAWAII REGION

The state of Hawaii is a defined region for this study. One city has been selected for study in this region -- Honolulu. Figure 3.3-6 depicts the Hawaii region and locates the case study city and reference cities. Geographic characteristics, land use/availability, and land values are evaluated for Honolulu in the following discussion.

3.3.6.1 Honolulu, Hawaii

3.3.6.1.1 Geography

Honolulu, the capital city, is located in the southeastern portion of the island of Oahu and is the home of the University of Hawaii. It lies to the southwest of the Koolau Range and is located on Mamala Bay. Ecologically, the area is considered as tropical rainforest and is classified as the Hawaiian Islands province. Vegetation is lush and varies according to the location on the island (lee side or windward side) and the altitude (Bailey 1976). Soils are complex, but uniform, and are a direct result of active

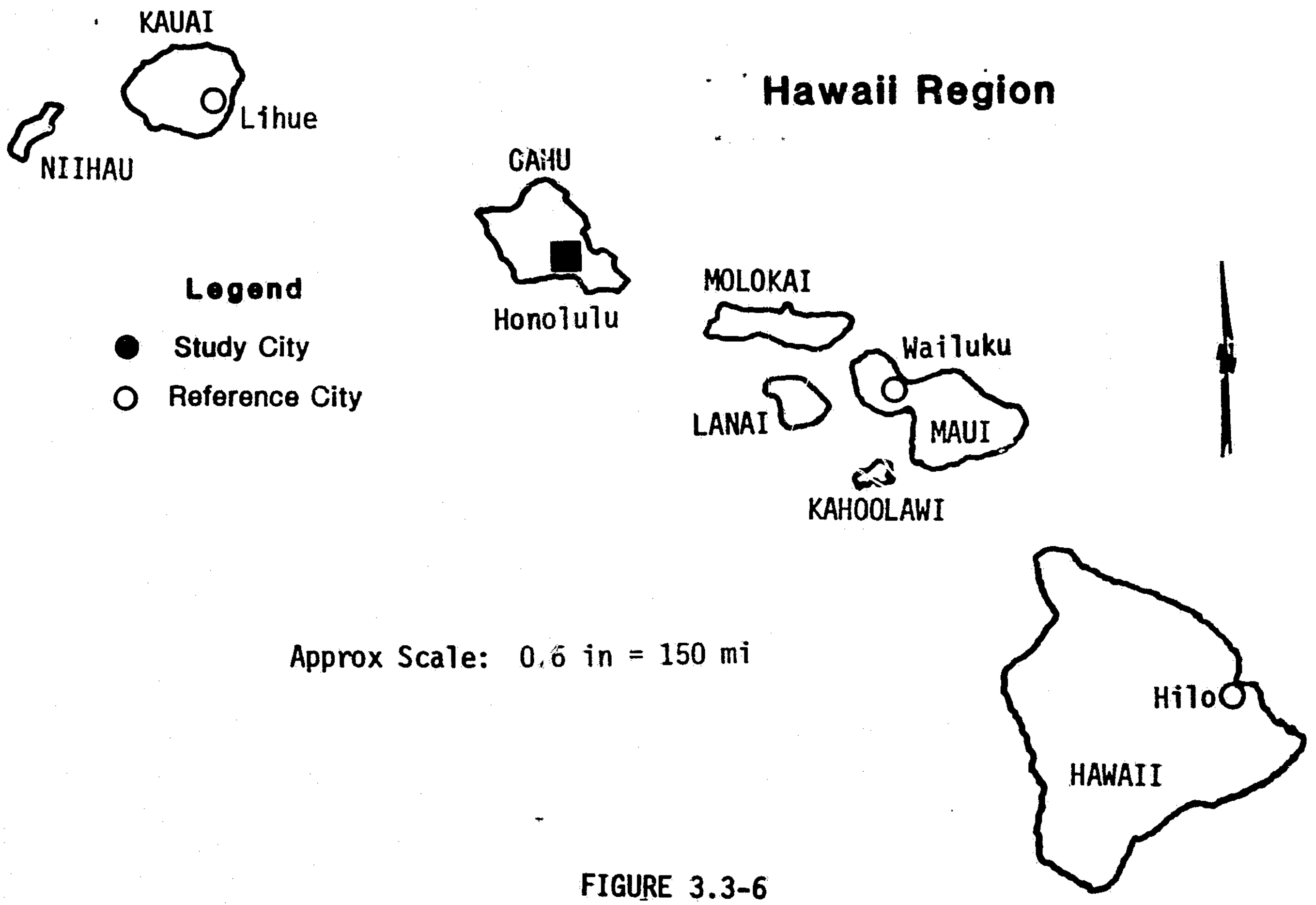

FIGURE 3.3-6

Location of Case Study Cities,
Hawaii Region

and inactive volcanoes and of corals in the surrounding waters. The reported 1980 population for Honolulu is 762,874, and the land area is 603.8 square miles (Young 1981).

3.3.6.1.2 Land Use/Land Availability

Table 3.3-40 contains the land-use information for Honolulu. The city has an unusually high ratio of institutional land uses (37 percent of the developed land in the city). This is largely due to the several military bases in Honolulu. Honolulu is also highly developed; only 18 percent of its land is undeveloped. The estimate for total pond-suitable land is between 32,091 and 36,714 acres. The maximum number of units permitted under existing zoning for developed land include 584,322 institutional units, 15,791 commercial units, and between 27,242 and 3,026,889 residential units. Corresponding data for undeveloped land are 124,322 additional institutional units, 3,357 additional commercial units, and between 5,796 and 644,000 additional residential units.

Information on the relationship between single family and multifamily residential development is found in Table 3.3-41. The estimate for total single family residential land is 28,743 acres, whereas the multifamily estimate is 4,295 acres. Square footage estimates for total single family space are 2.8 billion square feet and 1.7 billion square feet for multifamily uses. Approximately 18 percent of the given square footage totals are potentially dedicated to undeveloped lands.

3.3.6.1.3 Land Values

Table 3.3-42 contains the land-value information for Honolulu. Property values for undeveloped land on Oahu are very expensive and generally available only as small lots. Larger tracts of land at a lower cost per acre are more readily available on the other islands (Aldridge 1981). Residential land ranges between $261,360 and $1,176,120 per acre for a subdivided but undeveloped acre. Commercial and institutional property is available for $348,480 per acre.

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TABLE 3.3-40

Land Use/Land Availability
Honolulu, HI

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	33,038	27,242	11-25	2,997-6,810	5,796	11-25	638-1,448
Commercial	2,202	1,816	34	617	386	34	131
Institutional	81,494	67,197	34	22,847	14,297	34	4,861
Other (MLU)	103,521	85,359	--	--	18,162	--	--
Total (city)	220,255	181,614	--	26,461-30,274	38,641	--	5,630-6,440

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	43,560	1.0	375	0.009	27,242	3,026,889	5,796	644,000
Commercial[e]	5,000	0.115	5,000	0.115	15,791	15,791	3,357	3,357
Institutional[f]	5,000	0.115	5,000	0.115	584,322	584,322	124,322	124,322

Source: Young 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-41

Single Family/Multifamily Residential Data
Honolulu, HI

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	27,242	87	23,701	13	3,541	5,796	87	5,042	13	754

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	1,527,066	1,535	906	2,344,046,310	1,383,521,796	68	32	324,899	1,535	906	498,719,965	294,358,494

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-40.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-40.

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TABLE 3.3-42

Land Values
Honolulu, HI

Development Category	Range	Average Cost per Acre
Residential	Low	$ 261,360
	Medium	435,600
	High	1,176,120
Commercial	Low	NA[a]
	Medium	348,480
	High	NA
Institutional	Low	NA
	Medium	348,480
	High	NA

Source: Aldridge 1981.

[a]Not available.

3.3.6.2 Regional Summary

Honolulu is the only city being evaluated for this region. Figure C-6 of Appendix C graphically displays the potential availability of PSL in the city. As shown, almost 5,000 acres of undeveloped institutional land could potentially be considered for solar pond development. Commercial land is not abundant.

Figure D-6 of Appendix D reveals the high cost of land in the Honolulu area. In comparing the two graphs, it is apparent that residential and institutional land are available but at a very high cost.

3.3.7 PACIFIC NORTHWEST REGION

Idaho, Oregon, and Washington are the states that make up the Pacific Northwest region. The cities selected for study in this region include Klamath Falls, Oregon (low density); Pendleton, Oregon (medium density); and Seattle, Washington (high density). Figure 3.3-7 depicts the Pacific Northwest region and locates the case study cities and additional reference cities. Discussions regarding geography, land use/availability, and land values for each city follow.

3.3.7.1 Klamath Falls, Oregon

3.3.7.1.1 Geography

Klamath Falls is located in southwestern Oregon and is the home of the Oregon Institute of Technology. Landforms vary because the city is located in a physiographic transition zone between the Basin and Range and Cascade-Sierra Mountain provinces. The area is characterized by high mountains and flat valley floors. The city is at an elevation above 4,000 feet msl, is drained by the Klamath River, and is located on the southeast side of Upper Klamath Lake. Vegetation is characteristic of the Ponderosa-Shrub Forest section of the Intermountain Sagebrush province. Sagebrush is the dominant species although a variety of plants are present (Bailey 1976). Soils are varied in the area and are not very productive. The reported 1980

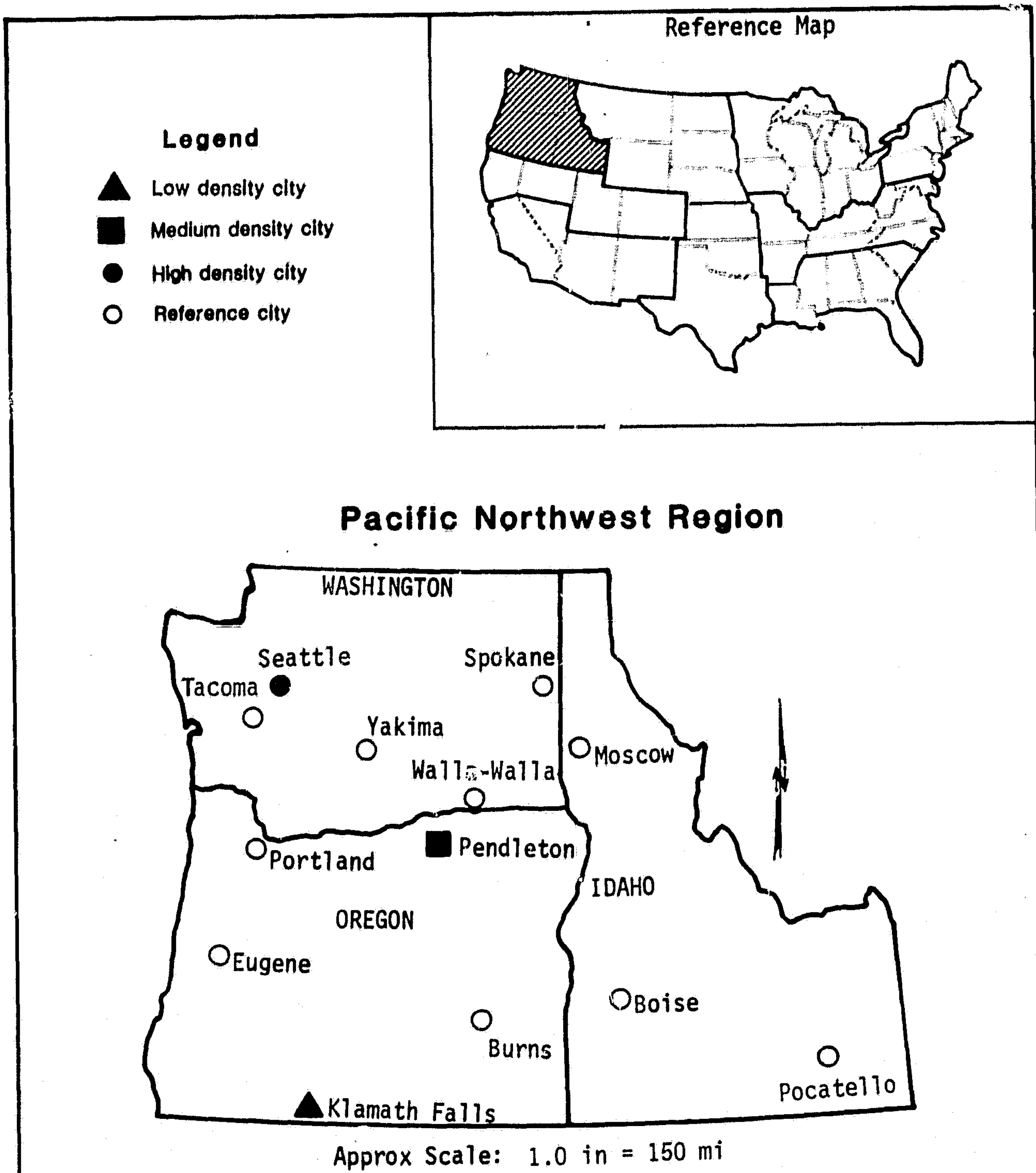

FIGURE 3.3-7

Location of Case Study Cities,
Pacific Northwest Region

population for Klamath Falls is 16,682, and the land area is 15.8 square miles (Green 1981).

3.3.7.1.2 Land Use/Land Availability

Klamath Falls has experienced a steady 6-percent growth rate over the past 20 years. Most of the development has been in the unincorporated areas around the city. Generally, there is a trend towards higher density residential development.

Table 3.3-43 contains the land-use/land-availability information for the city. Institutional land comprises 36 percent of the total land use. Total PSL ranges between 2,251 and 2,459 acres. The maximum number of units permitted by the present zoning code for developed land is 7,398 to 51,783 units for residential, 2,261 units for commercial, and 19,878 units for institutional. The number of units permitted for undeveloped land are slightly less.

As found in Table 3.3-44, the estimates for total single family/multifamily residential uses are 2,006 and 300 acres, respectively. This land area has the potential to support about 34 million square feet of single family dwelling space and 17 million square feet of multifamily space. About 48 percent of this space is estimated to be available on undeveloped lands.

3.3.7.1.3 Land Values

Table 3.3-45 presents Klamath Falls land costs. As shown, land values are extremely high in the area. Although individual lots cost between $10,000 to $50,000 per lot the total cost of an acre of subdivided, but undeveloped, land is between $43,000 and $215,000. The range for commercial and institutional property is between $65,340 and $326,700 per acre for developed property.

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TABLE 3.3-43

Land Use/Land Availability
Klamath Falls, OR

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	2,305	1,191	25-34	298-405	1,114	25-34	279-379
Commercial	503	260	34	88	243	34	83
Institutional	4,423	2,286	34	777	2,137	34	727
Other (MLU)	4,901	2,533	--	--	2,368	--	--
Total (city)	12,132	6,270	--	1,163-1,270	5,862	--	1,088-1,189

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	7,000	.161	1,000	.023	7,398	51,783	6,919	48,435
Commercial[e]	5,000	.115	5,000	.115	2,261	2,261	2,113	2,113
Institutional[f]	5,000	.115	5,000	.115	19,878	19,878	18,583	18,583

Source: Green 1981.

[a] Data in column 2 divided by data in column 8.
[b] Data in column 2 divided by data in column 9.
[c] Data in column 5 divided by data in column 8.
[d] Data in column 5 divided by data in column 9.
[e] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f] Assume minimum lot sizes are the same as commercial.

TABLE 3.3-44

Single Family/Multifamily Residential Data
Klamath Falls, OR

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	1,191	87	1,036	13	155	1,114	87	969	13	145

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	29,591	1,535	906	30,887,086	8,579,022	68	32	27,677	1,535	906	2,888,925	8,024,116

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-43.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-43.

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TABLE 3.3-45

Land Values
Klamath Falls, OR

Development Category	Range	Average Cost per Acre
Residential	Low	$ 43,000
	Medium	NA[a]
	High	215,000
Commercial	Low	65,340
	Medium	NA
	High	326,700
Institutional	Low	65,340
	Medium	NA
	High	326,700

Source: Sacher 1981.

[a]Not available.

3.3.7.2 Pendleton, Oregon

3.3.7.2.1 Geography

Pendleton is located in northeastern Oregon and supports a 2-year community college and Eastern Oregon State Hospital. It is located in the Walla Walla Plateau section of the Columbia Plateau physiographic province and is characterized by a rolling plateau with young incised valleys (Fenneman 1946). Elevation is about 1,300 feet msl. The city is located on the Umatilla River west of the Blue Mountains and the Umatilla Indian Reservation. Vegetative patterns in the area are characteristic of the Palouse Grassland province and include various types of rangeland (Bailey 1976). Soils are classified as chestnut (Strahler 1969). The reported 1980 population for Pendleton is 14,549, and the land area is 8.6 square miles (Rhodes 1981).

3.3.7.2.2 Land Use/Land Availability

Land-use patterns in the Pendleton area are linked heavily to the transportation networks and the natural resources in the area, as shown in Figure B-10 of Appendix B. Development to the east stretches along the Umatilla River and to the south in the Birch Creek basin. Land use surrounding Pendleton and the above-mentioned fringe development is dominated by abundant cropland and pastureland (21).

Pendleton has experienced slow but steady growth over the past 10 years. Industrial development is an important concern for the community. The city has a large tract of industrial land at the airport that might be suitable for solar pond development (Rhodes 1981).

As shown on Table 3.3-46, approximately half of Pendleton's total acreage is undeveloped land. Total PSL ranges between 1,499 to 1,807 acres. The maximum number of residential units permitted by the zoning code is between 12,239 and 67,560 units for developed land and between 12,601 and 67,560 units for undeveloped land. For commercial land, the figures are 3,449 units for developed property and 3,551 for undeveloped property. The

TABLE 3.3-46

Land Use/Land Availability
Pendleton, OR

Development Category	(1) Total Acres	Developed Acres: (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres: (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	3,428	1,689	25-34	422-574	1,739	25-34	435-591
Commercial	966	476	34	162	490	34	167
Institutional	921	454	34	154	467	34	159
Other (MLU)	465	229	--	--	236	--	--
Total (city)	5,780	2,848	--	738-890	2,932	--	761-917

Development Category	Prescribed Density: (8) Low: Minimum Lot Size (ft^2)	Acres	(9) High: Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land: (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land: (12) Low (units)[c]	(13) High (units)[d]
Residential	6,000	.138	1,089	.025	12,239	67,560	12,601	69,560
Commercial[e]	6,000	.138	6,000	.138	3,449	3,449	3,551	3,551
Institutional[f]	6,000	.138	6,000	.138	3,290	3,290	3,384	3,384

Source: Rhodes 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

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estimates for institutional land are 3,290 units (developed) and 3,384 units (undeveloped).

Information about the ratio between single family and multifamily residential uses is found on Table 3.3-47. Total single family land use is 2,982 acres. Multifamily use totals 446 acres. There are an estimated 84 million square feet of single family space and 23 million square feet of multifamily space potentially available in the city. Fifty-one percent of the total square footage exists in the undeveloped sectors of the city.

3.3.7.2.3 Land Values

Table 3.3-48 presents land-value information for Pendleton. Large, subdividable tracts (30 to 100 acres) exhibit modest costs, ranging from $2,000 to $4,000 per acre (Imsland 1981). Undeveloped, subdivided residential land ranges from $11,000 to $25,000 per acre. Commercial and institutional land is somewhat higher.

3.3.7.3 Seattle, Washington

3.3.7.3.1 Geography

Seattle is located in northwestern Washington and is the home of the University of Washington. It is part of the Puget Trough section of the Pacific Border physiographic province and is characterized by diverse lowlands (Fenneman 1946). Seattle is at elevation 500 feet msl and is located on Puget Sound and Lake Washington. Ecologically, it is part of the Willamette-Puget Forest province that, prior to cultivation, consisted of a dense coniferous forest that included red cedar, hemlock, and Douglas fir (Bailey 1976). Soils are classified as gray-brown podzolic that are commonly found in forested regions (Strahler 1969). Seattle had a 1980 population of 493,850, and a land area of 91.6 square miles (Moehring 1981).

TABLE 3.3-47

Single Family/Multifamily Residential Data
Pendleton, OR

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	1,689	87	1,469	13	220	1,739	87	1,513	13	226

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	39,900	1,535	906	41,647,620	11,567,808	68	32	41,081	1,535	906	42,880,348	11,910,204

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-46.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-46.

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TABLE 3.3-48

Land Values
Pendleton, OR

Development Category	Range	Average Cost per Acre
Residential	Low	$ 11,000
	Medium	16,000
	High	25,000
Commercial[a]	Low	87,120
	Medium	130,680
	High	196,020
Institutional[a]	Low	87,120
	Medium	130,680
	High	196,020

Source: Imsland 1981.

[a]Values reported are for 2.5-acre tracts of land.

3.3.7.3.2 Land Use/Land Availability

Urban development is very concentrated in the Seattle area, as indicated in Figure B-11 of Appendix B. Open space is limited to small parcels of forest (category 4) found throughout the city. Water resources are very evident west of the city (Puget Sound (54)) and in the southern portion (Lake Washington (52)).

Seattle has a solar energy program and has done work on solar access policy. The city is also experiencing a considerable downtown office building boom and suburban industrial development.

Table 3.3-49 presents Seattle's land-use/land-availability data. As indicated, Seattle is 89 percent developed with between 9,451 and 11,644 acres of PSL. The maximum number of residential units permitted by the present zoning code is between 98,577 and 1,204,833 units for developed land and an additional 12,182 to 148,888 units for undeveloped land. For institutional land, the figure is 82,826 units for developed land and 10,239 units for undeveloped land. For developed commercial property, the estimate is 12,739 units with 1,576 units estimated for undeveloped land.

Single family/multifamily residential data are found in Table 3.3-50. The estimate for total single family land is 21,200 acres, whereas for multifamily the estimate is 3,167 acres. A total of 764 million square feet of single family space and 212 million square feet of multifamily space is estimated for the city. Approximately 11 percent of this space is available in the undeveloped portions of Seattle.

3.3.7.3.3 Land Values

Land values in Seattle are very high as shown in Table 3.3-51. In 1967, only 10 percent of Seattle's total land area was vacant. The high density nature of the city has contributed to the high land prices. Land values outside the commercial core of the city are rather comparable to all other sections of the city (Peterson 1981).

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TABLE 3.3-49

Land Use/Land Availability
Seattle, WA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	24,367	21,687	25-34	5,422-7,374	2,680	25-34	670-911
Commercial	1,317	1,172	34	399	145	34	49
Institutional	8,562	7,620	34	2,591	942	34	320
Other (MLU)	24,372	21,691	--	--	2,681	--	--
Total (city)	58,618	52,170	--	8,412-10,354	6,448	--	1,039-1,280

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	9,600	.220	800	.018	98,577	1,204,833	12,182	148,888
Commercial[e]	4,000	.092	4,000	.092	12,739	12,739	1,576	1,576
Institutional[f]	4,000	.092	4,000	.092	82,826	82,826	10,239	10,239

Source: Moehring 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-50

Single Family/Multifamily Residential Data
Seattle, WA

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	21,687	87	18,868	13	2,819	2,680	87	2,332	13	348

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	651,705	1,535	906	680,250,000	188,940,000	68	32	80,535	1,535	906	84,062,433	23,348,707

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-49.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-49.

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TABLE 3.3-51

Land Values
Seattle, WA

Development Category	Range	Average Cost per Acre
Residential	Low	$160,000
	Medium	200,000
	High	600,000
Commercial	Low	435,600
	Medium	871,200
	High	6,534,000
Institutional	Low	435,600
	Medium	871,200
	High	6,534,000

Source: Peterson 1981.

3.3.7.4 Regional Summary of Cities

Figure C-7 of Appendix C presents land-availability comparisons for the three cities. Seattle is by far the largest city (60,000 acres) but is more densely populated and does not have a proportional amount of PSL. Pendleton appears to have a good supply of undeveloped land committed to residential development, whereas Klamath Falls has about 700 acres of undeveloped institutional land potentially available for solar ponds.

Figure D-7 of Appendix D compares land prices in the three cities. The most attractive land prices appear to be in Pendleton, especially residential property. Data from the two graphs indicate Pendleton to have about 600 acres of PSL at reasonable prices.

3.3.8 PUERTO RICO REGION

The country of Puerto Rico is a defined region for this study. One city has been selected for study in this region -- San Juan. Figure 2.3-1 shows the Puerto Rico region and locates San Juan.

Acquiring data for the San Juan area was a difficult task. Appendix F presents a summary of the Puerto Rico region and its relationship to the other regions. These data are developed as an appendix due to the late arrival of the data and problems encountered in formatting the information into the final report.

3.3.9 RED RIVER REGION

As previously defined, the Red River region is comprised of the states of Kansas, Oklahoma, and Texas. The cities selected for study in this region include Oklahoma City, Oklahoma (low density); Waco, Texas (medium density); and Liberal, Kansas (high density). Figure 3.3-8 delineates the Red River region and locates the case study cities and additional reference cities. The following discussions are designed to evaluate the general geographic characteristics of each city, land use/availability, and land values.

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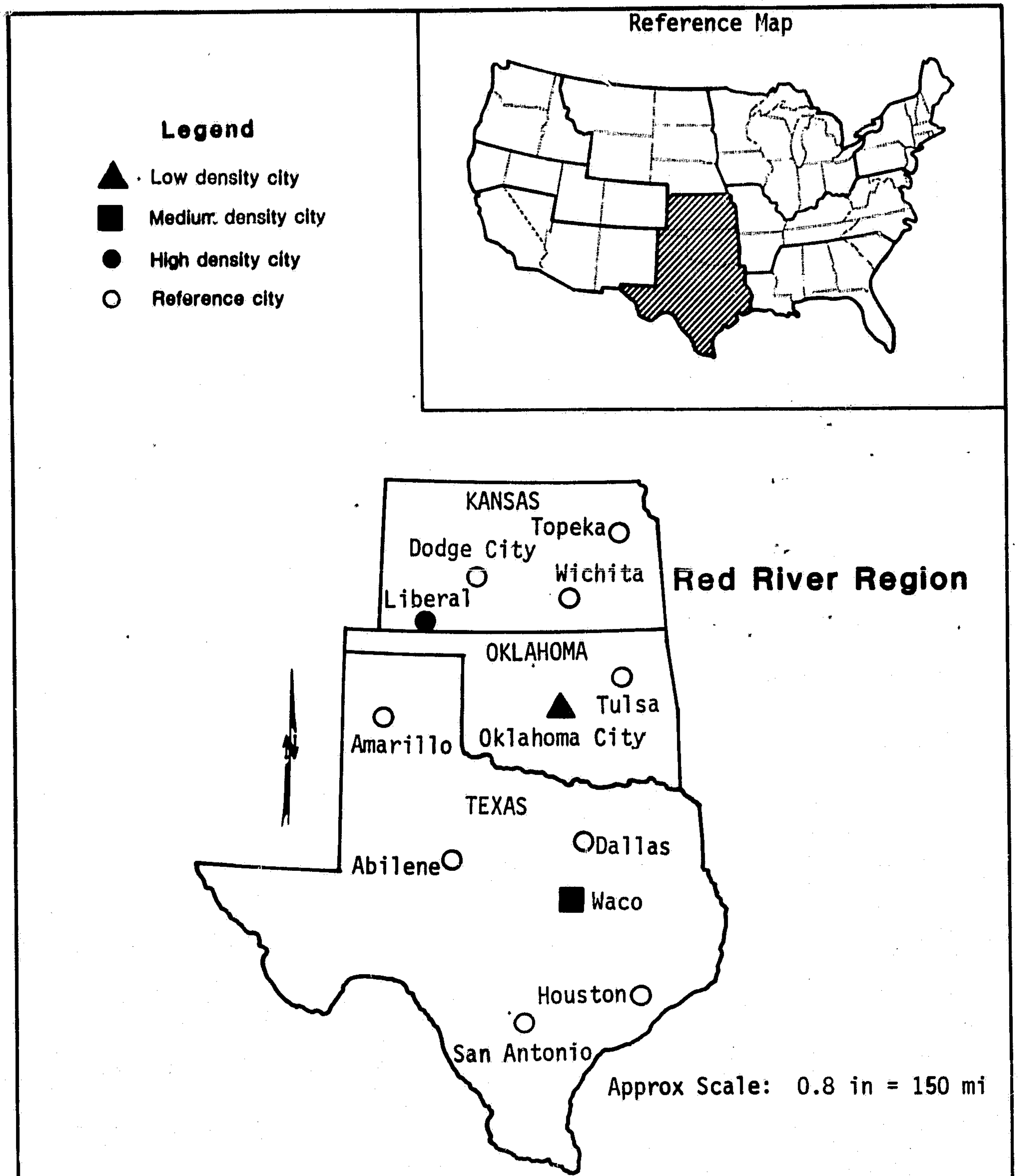

FIGURE 3.3-8

Location of Case Study Cities,
Red River Region

3.3.9.1 Oklahoma City, Oklahoma

3.3.9.1.1 Geography

Oklahoma City (OKC), the capital city, is located in central Oklahoma. Several educational institutions are located within the city, including Oklahoma City University. OKC is at elevation 1,180 msl and is drained by the North Canadian River, an Arkansas River tributary. OKC is located in the Interior Plains physiographic division, Central Lowland province, Osage Plains section. This section is characterized by old scarped plains, faintly inclined strata, and entrenched main streams (Fenneman 1946). Ecologically, OKC is in the Prairie division, in a transition zone between the Oak/Bluestem Parkland and the Bluestem/Grama Prairie. Vegetation is generally characterized as tallgrass/parkland. The primary soil order is the prairie soil that is a transition soil (Bailey 1976). The reported 1980 population is 401,577 and has an associated land area of 621 square miles.

3.3.9.1.2 Land Use/Land Availability

OKC has experienced steady economic and population growth since the 1970s due to the abundance of available nearby energy resources and its central location. Although the comprehensive plan adopted in 1977 advocated balanced growth, the city has not been totally successful in implementing this policy.

Table 3.3-52 presents land availability data for OKC. Approximately 75 percent (296,482 acres) of OKC's total land area is undeveloped land of which 147,302 acres are projected to develop in residential, commercial, and institutional land uses.

For undeveloped land the estimated maximum building units permitted are 107,549 to 4,676,043 additional residential units, 19,329 to 128,580 commercial units, and 24,073 to 160,138 institutional units. Total PSL is between 58,534 and 62,862 acres.

TABLE 3.3-52

Land Use/Land Availability
Oklahoma City, OK

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	144,289	36,740	28-31	10,287-11,389	107,549	28-31	30,114-33,340
Commercial	23,806	6,062	34	2,061	17,744	34	6,033
Institutional	29,529	7,519	34	2,556	22,099	34	7,483
Other (MLU)	200,149	50,969	--	--	149,180	--	--
Total (city)	397,770	101,290	--	14,904-16,006	296,482	--	43,630-46,856

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	43,560	1.00	1,000	.023	36,740	1,597,391	107,549	4,676,043
Commercial[e]	4,000	.918	6,000	.138	6,603	43,928	19,329	128,580
Institutional[f]	4,000	.918	6,000	.138	8,191	54,486	24,073	160,138

Source: Minar 1981.

[a] Data in column 2 divided by data in column 8.
[b] Data in column 2 divided by data in column 9.
[c] Data in column 5 divided by data in column 8.
[d] Data in column 5 divided by data in column 9.
[e] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f] Assume minimum lot sizes are the same as commercial.

Table 3.3-53 contains the single family/multifamily residential data for OKC. It is estimated that there are 125,702 acres of single family land and 18,757 acres of multifamily land within OKC. This land has the potential of supporting a total of 3.3 billion square feet of single family space and 930 million square feet of multifamily space. About 75 percent of this square footage is predicted to be available for undeveloped land.

3.3.9.1.3 Land Values

Table 3.3-54 indicates that some residential land is available in OKC for less than $7,000 per acre. Institutional and commercial land is available for about $22,000 per acre. The considerable range in land values may be a function of the difference between undeveloped (raw) land and developed land.

3.3.9.2 Waco, Texas

3.3.9.2.1 Geography

Waco is located in east-central Texas and is the home of Baylor University and Paul Quinn College. It is at elevation 550 msl and is located at the confluence of the Bosque and Brazos rivers. Waco is located in the transition zone between the Interior Plains and the Atlantic Plain physiographic division. Western Waco is more typical of the Great Plains province, Central Texas section, and is characterized by mature plateaus in the later stages of erosion. Eastern Waco is more representative of the Coastal Plain province, West Gulf Coastal Plain section, and is characterized by a mature coastal plain (Fenneman 1946). Ecologically, Waco is in the Prairie division, Prairie Parkland province, Oak-Bluestem Parkland section. Vegetation is characteristic of the forest-steppe with an integration of prairie, groves, and deciduous trees (Bailey 1976). Soils are intrazonal and characterized as rendzina (calcimorphic soils) (Strahler 1969). The reported 1980 population for Waco is 101,267, and the 1980 land area is 86.3 square miles (Ringo 1981).

TABLE 3.3-53

Single Family/Multifamily Residential Data
Oklahoma City, OK

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	36,740	87	31,964	13	4,776	107,549	87	93,742	13	13,981

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	817,066	1,535	906	852,850,000	236,880,000	68	32	2,391,796	1,535	906	2,496,600,000	693,430,000

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-52.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-52.

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TABLE 3.3-54

Land Values
Oklahoma City, OK

Development Category	Range	Average Cost per Acre
Residential	Low	$ 6,790
	Medium	51,183
	High	114,345
Commercial	Low	21,780
	Medium	201,465
	High	457,300
Institutional	Low	21,780
	Medium	201,465
	High	457,300

Source: Rice 1981.

3.3.9.2.2 Land Use/Land Availability

Figure B-12 of Appendix B reveals land-use patterns in the Waco area. The urban fringe residential (11) and commercial (12) development is primarily to the north, west, and south. Cropland (21), rangeland (32), and forestland (42 and 43) are scattered throughout the area.

Current growth trends for Waco are towards a slow but steady rate of growth (Ringo 1981). There has been some increase in industrial activity due to the recent establishment of a warehousing and distribution center. Higher density residential developments such as apartments, condominiums, and planned unit developments also are being built.

Table 3.3-55 presents land-availability data for Waco. Nearly 72 percent (34,596 acres) of Waco's total land area is undeveloped land. Waco also has a relatively high amount (26 percent) of its total land area developed as institutional uses. For undeveloped land the maximum number of units permitted are 44,036 to 484,400 residential units, 12,536 commercial units, and 65,181 institutional units. Total PSL is between 9,640 and 10,137 acres.

Table 3.3-56 contains single family/multifamily residential data for Waco. The ratio of single family to multifamily land use is 14,433 acres to 2,156 acres, respectively. A total of 378 million square feet of single family space and 105 million square feet of multifamily space is estimated for the developed and undeveloped portions of the city, of which 73 percent is projected for the undeveloped areas.

3.3.9.2.3 Land Values

The value of land in Waco as shown in Table 3.3-57 is relatively inexpensive. Housing lot costs are between $2,500 and $10,000 per acre. For commercial and institutional land, the values range between $43,560 and $261,360 per acre. Land values (especially for commercial property) have been unstable over the past year due to the completion of a regional shopping mall in the area (Stewart 1981). As a result, land costs have increased within that period.

TABLE 3.3-55

Land Use/Land Availability
Waco, TX

Development Category	(1) Total Acres	Developed Acres: (2) Total Developed Acres	Developed Acres: (3) Percentage of Pond-Suitable Land	Developed Acres: (4) Total Pond-Suitable Land (acres)	Undeveloped Acres: (5) Total Undeveloped Acres	Undeveloped Acres: (6) Percentage of Pond-Suitable Land	Undeveloped Acres: (7) Total Pond-Suitable Land (acres)
Residential	16,589	4,479	28-31	1,254-1,388	12,110	28-31	3,391-3,754
Commercial	2,370	640	34	218	1,730	34	588
Institutional	12,322	3,327	34	1,131	8,995	34	3,058
Other (MLU)	16,111	4,350	--	--	11,761	--	--
Total (city)	47,392	12,796	--	2,603-2,737	34,596	--	7,037-7,400

Development Category	Prescribed Density: (8) Low: Minimum Lot Size (ft^2)	Prescribed Density: (8) Low: Acres	Prescribed Density: (9) High: Minimum Lot Size (ft^2)	Prescribed Density: (9) High: Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land: (10) Low (units)[a]	Maximum Units Permitted Under Existing Zoning Code for Developed Land: (11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land: (12) Low (units)[c]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land: (13) High (units)[d]
Residential	12,000	.275	1,089	.025	16,287	179,160	44,036	484,400
Commercial[e]	6,000	.138	6,000	.138	4,638	4,638	12,536	12,536
Institutional[f]	6,000	.138	6,000	.138	24,109	24,109	65,181	12,536

Source: Ringo 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-56

Single Family/Multifamily Residential Data
Waco, TX

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	4,479	87	3,897	13	582	12,110	87	10,536	13	1,574

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	97,724	1,535	906	102,000,000	28,332,142	68	32	264,218	1,535	906	275,790,000	76,602,083

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-55.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-55.

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TABLE 3.3-57

Land Values
Waco, TX

Development Category	Range	Average Cost per Acre
Residential	Low	$ 2,500
	Medium	8,000
	High	10,000
Commercial	Low	43,560
	Medium	152,460
	High	261,360
Institutional	Low	43,560
	Medium	152,460
	High	261,360

Source: Patrick 1981.

3.3.9.3 Liberal, Kansas

3.3.9.3.1 Geography

Liberal is located in extreme southwestern Kansas just north of the Oklahoma panhandle. It is at elevation 2,850 msl and is located near the Cimarron River. Physiographically, Liberal is contained in the Interior Plains division, Great Plains province, High Plains section, and is characterized by wide intervalley remnants of smooth fluviatile plains (Fenneman 1946). The Liberal area is in an ecoregion described as the Steppe division, Great Plains Shortgrass Prairie province, Grama-Buffalo Grass section. Vegetation is distinguished by bunched and sparsely distributed shortgrasses with occasional scattered trees and shrubs. Ground cover is scarce, and much soil is exposed (Bailey 1976). Soils are described as reddish chestnut (dark-colored soils of the semiarid, subhumid, and humid grassland) (Strahler 1969). The reported 1980 population is 16,500, and the city land area totals 6.3 square miles (Hansen 1981).

3.3.9.3.2 Land Use/Land Availability

Figure B-13 of Appendix B presents general land-use patterns in the Liberal area. Residential (11) and commercial (12) development is basically confined to the city limits. The area outside the city limits and within the black circle is predominantly cropland (21), although there is some scattered herbaceous rangeland (31).

Due to the presence of natural gas supplies, Liberal, Kansas, is experiencing a moderate growth rate with 100 to 200 new residential units per year. The city is attracting a younger (25 to 40 years old) working-class population as a result of new industrial development.

Table 3.3-58 contains land-use/land-availability data for Liberal. Nineteen percent (786) of Liberal's land area is undeveloped land. Fifty-nine percent of this undeveloped land (460 acres) is being held for industrial development. Total estimated undeveloped residential land in Liberal ranges

TABLE 3.3-58

Land Use/Land Availability
Liberal, KS

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	1,238	995	28-31	279-308	243	28-31	68-75
Commercial	264	212	34	72	52	34	18
Institutional	160	129	34	44	31	34	11
Other (MLU)	2,338	1,878	--	--	460	--	--
Total (city)	4,000	3,214	--	395-424	786	--	97-104

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	130,680	3.0	2,000	.046	332	21,630	81	5,283
Commercial[e]	5,000	.115	5,000	.115	1,843	1,843	452	452
Institutional[f]	5,000	.115	5,000	.115	1,122	1,122	270	270

Source: Hansen 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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between 522 and 551 acres. Commercial uses are estimated to include 124 acres while institutional is 75 acres. The estimate for PSL is between 492 and 528 acres.

As shown in Table 3.3-59, total single family land is estimated at 1,077 acres while multifamily land is estimated at 161 acres. About 14 million and 4 million square feet are estimated to be potentially available for single family and multifamily use, respectively, of which about 20 percent could be committed to undeveloped lands.

3.3.9.3.3 Land Values

Table 3.3-60 depicts land-value information for Liberal. The values given for institutional property ($8,000 to $10,000) in Liberal are probably a closer approximation of the true cost of undeveloped land in the area. Values for residential property range from $25,920 to $35,640 per acre. Commercial property ranges between $130,500 and $174,000 per acre.

3.3.9.4 Regional Summary of Cities

Figure C-8 of Appendix C compares PSL for the three cities in this region. Oklahoma City has by far the most land and Liberal the least. Both OKC and Waco appear to have an abundant amount of PSL in the undeveloped sectors of all three land-use categories. Liberal shows only limited potential. The three cities show over 50,000 acres of undeveloped PSL.

3.3.10 SALT LAKE REGION

The Salt Lake region is one of two regions that are not divided strictly along political boundaries. As previously acknowledged, the Salt Lake region includes the states of Colorado, Utah, northern Nevada, and northern California. The cities selected for study include Carson City, Nevada (low density); Durango, Colorado (medium density); and Davis, California (high density). Figure 3.3-9 highlights the location of the region and locates the case study cities and additional reference cities. These cities will be

TABLE 3.3-59

Single Family/Multifamily Residential Data
Liberal, KS

Development Category	Developed Land: Total Acres	Developed Land: Single Family		Developed Land: Multifamily		Undeveloped Land: Total Acres	Undeveloped Land: Single Family		Undeveloped Land: Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	995	87	866	13	129	243	87	211	13	32

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	10,981	1,535	906	11,461,968	3,183,612	68	32	2,682	1,535	906	2,799,472	777,565

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-58.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-58.

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TABLE 3.3-60

Land Values
Liberal, KS

Development Category	Range	Average Cost per Acre
Residential	Low	$ 25,920
	Medium	30,780
	High	35,640
Commercial	Low	130,500
	Medium	152,250
	High	174,000
Institutional	Low	8,000
	Medium	9,000
	High	10,000

Source: Bushart 1981.

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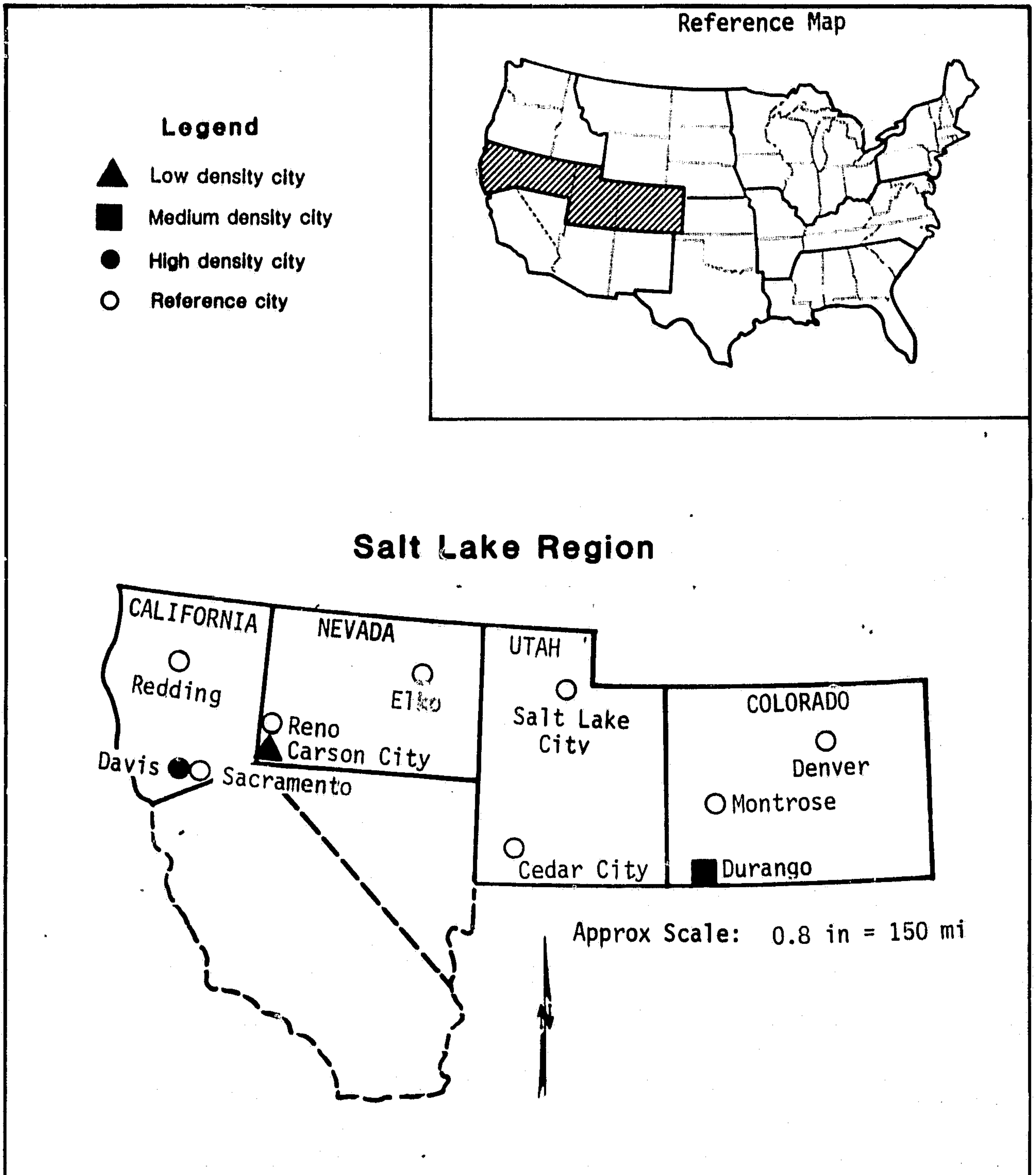

FIGURE 3.3-9

Location of Case Study Cities,
Salt Lake Region

further evaluated regarding geography, land use/availability, and land values in the following discussion.

3.3.10.1 Carson City, Nevada

3.3.10.1.1 Geography

Carson City is located in west-central Nevada, south of Reno, and supports Western Nevada Community College and two penal institutions. Physically, it is in a transition zone within the Great Basin section of the Basin and Range province to the east and the Sierra Nevada section of the Cascade-Sierra Mountain province to the west. To the east of the city, isolated mountain ranges (Pine Nut Mountains and Virginia Range) are separated by aggraded desert plains. To the west lie the Sierra Nevadas, and specifically the Carson Range, that is a block mountain range (Fenneman 1946). Carson City is about 4,700 feet msl and is located due east of Lake Tahoe. Vegetation is generally classified as belonging to the Lahontan Saltbush-Greasewood section of the Intermountain Sagebrush province. Approximately 50 percent of Carson City is open grassland (Sullivan 1981). Soils are classified as lithosols (Strahler 1969). The reported 1980 population is 32,022, and the city land area totals 150 square miles (Sullivan 1981).

3.3.10.1.2 Land Use/Land Availability

Urban development in the Carson City area is fairly concentrated, as is evident in Figure B-14 of Appendix B. The immediate surrounding land use is dominated by shrub and brush rangeland (32).

Resource management, especially of water, is a key issue in Carson City. Unless a bond issue for water and sewer extensions is approved in 1982, the city will reach the growth limit established by the comprehensive plan. There is presently a building moratorium in Carson City.

As shown in Table 3.3-61 over half of Carson City's total land area is undeveloped. There is also a relatively high amount of institutional land

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TABLE 3.3-61

Land Use/Land Availability
Carson City, NV

Development Category	(1) Total Acres	Developed Acres: (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres: (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	3,126	1,415	28-37	396-524	1,711	28-37	479-633
Commercial	411	186	34	63	225	34	77
Institutional	4,577	2,072	34	705	2,505	34	852
Other (MLU)	10,456	4,733	--	--	5,723	--	--
Total (city)	18,570	8,406	--	1,164-1,292	10,164	--	1,408-1,562

Development Category	Prescribed Density: (8) Low: Minimum Lot Size (ft^2)	Acres	(9) High: Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land: (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land: (12) Low (units)[c]	(13) High (units)[d]
Residential	217,800	5.00	1,000	.023	283	61,522	342	74,391
Commercial[e]	9,000	:207	6,000	.138	899	1,348	1,087	1,630
Institutional[f]	43,560	1.00	6,000	.138	2,072	15,014	2,505	18,152

Source: Sullivan 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

(25 percent). Total PSL is estimated between 2,572 to 2,854 acres. Under the existing zoning code, estimates for maximum residential units are from 282 to 61,522 for developed land and 342 to 74,391 for undeveloped land. For commercial units, the figures are 899 to 1,348 units (developed) and 1,087 to 1,630 units undeveloped. Estimates for institutional land are 2,072 to 15,014 developed units plus 2,505 to 18,152 additional units on undeveloped land.

Table 3.3-62 contains the single family/multifamily residential data for Carson City. There is an estimated total of 2,720 acres of single family residential land and 406 acres of multifamily land in Carson City. Square footage estimates include 61 million and 20 million square feet of total space for single family and multifamily units, respectively, of which 45 percent and 55 percent potentially exist as developed space and undeveloped space, respectively.

3.3.10.1.3 Land Values

Land prices for Carson City are presented in Table 3.3-63. A building moratorium is currently in effect in Carson City. High land costs can be attributed to the moratorium and the close proximity of Lake Tahoe to the west and the Toiyabe National Forest to the northwest. The values shown in the table are for undeveloped parcels with urban services.

3.3.10.2 Durango, Colorado

3.3.10.2.1 Geography

Durango is located in southwestern Colorado and is the home of Fort Lewis College. It is located in the Navajo section of the Colorado Plateau physiographic division that is characterized by young plateaus. The city is located on the Animas River. Vegetation is somewhat transitional from the juniper-pinon woodlands to the ponderosa pine-Douglas fir forest (Bailey 1976). Soils are classified as lithosols (Strahler 1969). The reported 1980 population is 13,000, and the land area is 3.4 square miles (Roser 1981).

TABLE 3.3-62

Single Family/Multifamily Residential Data
Carson City, NV

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	1,415	87	1,231	13	184	1,711	87	1,489	13	222

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	30,903	1,535	906	21,934,455	8,959,398	68	32	37,367	1,535	906	39,003,675	10,833,441

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-61.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-61.

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TABLE 3.3-63

Land Values
Carson City, NV

Development Category	Range	Average Cost per Acre
Residential	Low	$ 30,000
	Medium	78,000
	High	180,000
Commercial	Low	155,000
	Medium	435,600
	High	525,000
Institutional	Low	155,000
	Medium	435,000
	High	525,000

Source: Copp 1981.

3.3.10.2.2 Land Use/Land Availability

Tourism is a major industry for Durango, and the market for vacation and retirement homes is very important. As indicated in Table 3.3-64, the city is 90 percent developed although the city is pursuing an active annexation policy. Total PSL is between 560 and 668 acres. The zoning code permits a maximum of 7,826 to 46,957 residential units, 2,848 commercial units, and 1,420 institutional units on the developed land. Corresponding figures for undeveloped land include 870 to 5,217 residential units, 319 commercial units, and 159 institutional units.

The ratio of single family to multifamily development is found in Table 3.3-65. There are 1,044 acres of total single family and 156 acres of total multifamily uses. Total square feet of residential space includes 32 million for single family and 9 million for multifamily, of which 10 percent potentially exists on undeveloped acreage.

3.3.10.2.3 Land Values

Table 3.3-66 presents land-value information for Durango. Durango's location near Colorado's ski areas has contributed to very positive growth trends and an active real estate market. Residential land with urban services is available for $29,000 per acre. Commercial land is appreciably higher.

3.3.10.3 Davis, California

3.3.10.3.1 Geography

Davis is located in northern California, due west of Sacramento, and is the home of the University of California at Davis. It is in the California Trough section of the Pacific Border province and is characterized by low fluviatile plains (Fenneman 1946). The city is at an elevation of 55-70 feet msl and is relatively flat. The surrounding area is known as the California Grassland ecoregion and is today characterized by some isolated stands of natural bunch grass but is most commonly dominated by introduced

TABLE 3.3-64

Land Use/Land Availability
Durango, CO

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	1,200	1,080	28-37	302-400	120	28-37	34-44
Commercial	437	393	34	134	44	34	15
Institutional	218	196	34	67	22	34	8
Other (MLU)	327	295	--	--	32	--	--
Total (city)	2,182	1,964	--	503-601	218	--	57-67

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	6,000	.138	1,000	.023	7,826	46,957	870	5,217
Commercial[e]	6,000	.138	6,000	.138	2,848	2,848	319	319
Institutional[f]	6,000	.138	6,000	.138	1,420	1,420	159	159

Source: Roser 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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TABLE 3.3-65

Single Family/Multifamily Residential Data
Durango, CO

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	1,080	87	940	13	140	120	87	104	13	16

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	27,392	1,535	906	28,591,770	7,941,489	68	32	3,044	1,535	906	3,177,327	882,517

[a] Single family.

[b] Multifamily.

[c] Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-64.

[d] Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-64.

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TABLE 3.3-66

Land Values
Durango, CO

Development Category	Range	Average Cost per Acre
Residential	Low	$ 29,000
	Medium	121,800
	High	290,000
Commercial	Low	174,240
	Medium	304,920
	High	653,400
Institutional	Low	NA[a]
	Medium	40,000[b]
	High	NA

Source: Willis 1981.

[a]Not available.

[b]Reported value is for a 10-acre tract of land.

annual grasses (Bailey 1976). Soils are classified as alluvial (Strahler 1969). The reported 1980 population for Davis is 36,626, and the land area is 7 square miles (Keller 1981).

3.3.10.3.2 Land Use/Land Availability

The growth management plan for Davis sets a growth cap at 50,000 people that is enforced by limitations on the number of building permits issued in a year. This issue will be reevaluated by the city council in the fall of 1981. Davis also has active solar energy and energy conservation programs.

As shown in Table 3.3-67, 88 percent of Davis total land area is developed. Most of the land (2,123 acres) is developed residentially. Total PSL in Davis is from 800 to 1,018 acres. The maximum number of residential building units permitted by the zoning code are 3,699 to 117,944 units on developed land and 493 to 15,722 units on undeveloped land. The estimates for commercial property are 727 units (developed) plus 99 units (undeveloped). For institutional property, the figures are 1,180 units (developed) and 157 units (undeveloped).

Table 3.3-68 contains the information on single family/multifamily development. Total single family acreage is 2,339 as compared to the multifamily acreage of 350. These estimates potentially could support 72 million square feet of single family space and nearly 20 million square feet of multifamily space, of which 12 percent could exist on undeveloped land.

3.3.10.3.3 Land Values

Table 3.3-69 presents land-value data for Davis. The Davis agricultural land-preservation/growth-management policy affects the value of land located within the urban development area. The low value for institutional and residential land is $20,000 per acre. The average value for agricultural land (class I soils) is $6,000 per acre (Mauvis 1981). Commercial land prices are appreciably inflated.

TABLE 3.3-67

Land Use/Land Availability
Davis, CA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	2,406	2,123	28-37	594-786	283	28-37	79-105
Commercial	142	125	34	43	17	34	6
Institutional	230	203	34	69	27	34	9
Other (MLU)	1,530	1,351	--	--	179	--	--
Total (city)	4,308	3,802	--	706-898	506	---	94-120

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	25,000	.574	800	.018	3,699	117,944	493	15,722
Commercial[e]	7,500	.172	7,500	.172	727	727	99	99
Institutional[f]	7,500	.172	7,500	.172	1,180	1,180	157	157

Source: Keller 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-68

Single Family/Multifamily Residential Data
Davis, CA

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	2,406	87	2,093	13	313	283	87	246	13	37

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	60,821	1,535	906	63,484,960	17,633,224	68	32	8,108	1,535	906	8,463,130	2,350,671

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-67.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-67.

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TABLE 3.3-69

Land Values
Davis, CA

Development Category	Range	Average Cost per Acre
Residential	Low	$ 20,000
	Medium	50,000
	High	125,000
Commercial	Low	348,486
	Medium	479,160
	High	609,840
Institutional	Low	NA[a]
	Medium	20,000
	High	NA

Source: Mauvis 1981.

[a]Not available.

3.3.10.4 Regional Summary of Cities

Carson City exhibits the most land area (about 20,000 acres) of the three case study cities, as shown in Figure C-9 of Appendix C. According to the bar graphs, PSL is at a premium in this region, but it is most likely to be found in Carson City where the potential for future development of institutional lands is high. Durango and Davis appear to be extremely limited for future development. Only about 2,000 acres of undeveloped PSL is available for these three cities, of which about 75 percent is in Carson City.

Land prices in the region are very comparable, as exhibited in Figure D-9 of Appendix D. The city of Davis does reflect lower residential and institutional low-range values. Since Durango and Davis only show minimal land availability, Carson City prices may represent the only alternative for this region.

3.3.11 SOUTH WEST REGION

This region, similar to the Salt Lake region, is not strictly divided along political boundaries. The states of this region include Arizona, New Mexico, southern California, and southern Nevada. Case study cities include Scottsdale, Arizona (low density); Carlsbad, New Mexico (medium density); and Whittier, California (high density). Figure 3.3-10 presents the case study cities and additional reference cities. Following are discussions about geography, land use/availability, and land values for each city.

3.3.11.1 Scottsdale, Arizona

3.3.11.1.1 Geography

Scottsdale, a suburb of Phoenix, is located in south-central Arizona. It is located in the Sonoran Desert section of the Basin and Range physiographic province and is characterized by widely spaced short ranges in desert plains (Fenneman 1946). Vegetation is classified in the Creosote Bush-Bur Sage section of the American Desert province and is characterized by low density

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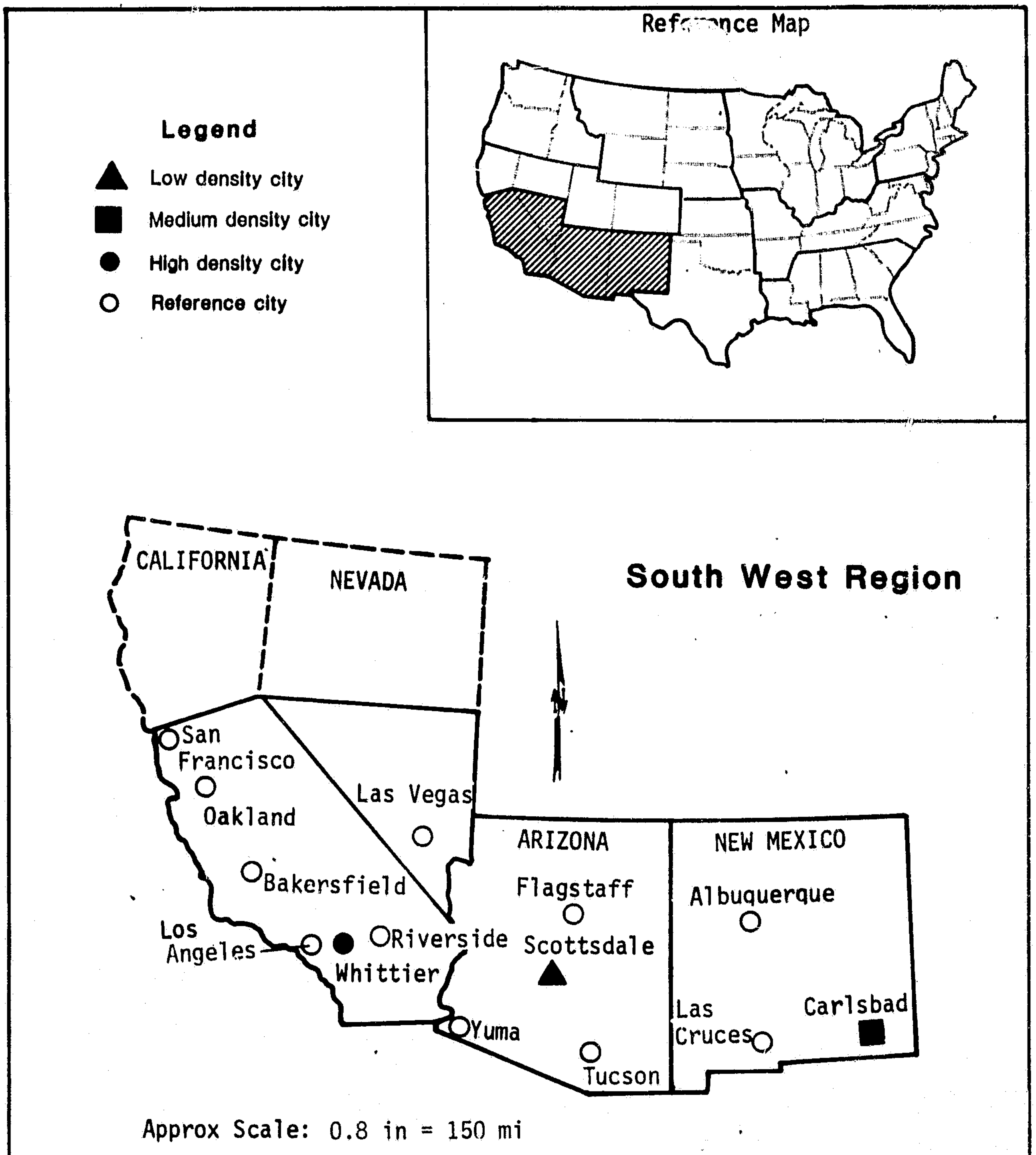

FIGURE 3.3-10

Location of Case Study Cities,
South West Region

and bare ground (Bailey 1976). Soils are classified as red desert soils typical of arid regions (Strahler 1969). The reported 1980 population for Scottsdale is 88,400, and the land area is 88.6 square miles (Hadder 1981).

3.3.11.1.2 Land Use/Land Availability

The Scottsdale area is shown in Figure B-15 of Appendix B. Land use is diversified and exhibits fairly large amounts of cropland and pastureland (21) in the eastern portion of the area. The western part of the area is primarily dedicated to residential (11) and commercial (12) development.

Development pressure is towards the north and the east in Scottsdale. The city is planning for a 25,000-population increase by the end of the century. Development trends favor multifamily housing to accommodate a smaller household size and a large part-time population.

Seventy-eight percent of Scottsdale's total land area, as shown in Table 3.3-70, is developed. Over half of this land is in uses other than residential, commercial, or institutional. Total PSL ranges between 5,759 to 9,872 acres. The range for maximum residential units permitted by the present zoning code is from 17,119 to 375,467 for existing units and from 4,813 to 105,556 additional units. The maximum permitted on commercial land is 14,882 units (developed land) and 4,186 units (undeveloped land). For institutional uses, estimates include 14,752 (developed) and 4,149 units (undeveloped).

Table 3.3-71 presents the single family/multifamily data for Scottsdale. There are 18,833 acres of total single family uses as compared to 2,813 acres of total multifamily uses. The single family/multifamily square footage ratio is 263 million to 73 million square feet, of which 22 percent potentially could be developed in the future on existing undeveloped lands.

TABLE 3.3-70

Land Use/Land Availability
Scottsdale, AZ

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	21,646	16,896	17-36	2,872-6,083	4,750	17-36	808-1,710
Commercial	3,070	2,396	34	815	674	34	229
Institutional	3,043	2,375	34	808	668	34	227
Other (MLU)	28,945	22,595	--	--	6,350	--	--
Total (city)	56,704	44,262	--	4,495-7,706	12,442	--	1,264-2,166

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft²)	Acres	(9) High Minimum Lot Size (ft²)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	43,000	.987	1,980	.045	17,119	375,467	4,813	105,556
Commercial[e]	7,000	.161	7,000	.161	14,882	14,882	4,186	4,186
Institutional[f]	7,000	.161	7,000	.161	14,752	14,752	4,149	4,149

Source: Hadder 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-71

Single Family/Multifamily Residential Data
Scottsdale, AZ

Development Category	Developed Land					Undeveloped Land				
		Single Family		Multifamily			Single Family		Multifamily	
	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage	Total Acres	Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	16,896	87	14,700	13	2,196	4,750	87	4,133	13	617

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	196,293	1,535	906	2.05×10^8	56,909,267	68	32	55,185	1,535	906	57,602,103	15,999,235

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-70.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-70.

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3.3.11.1.3 Land Values

The price of land in Scottsdale is shown in Table 3.3-72. The cheapest land values are found in area 5, a hilly region on the north side of Scottsdale. The city is presently studying this area and considering development options. Medium values for all land uses average around $25,000 per acre.

3.3.11.2 Carlsbad, New Mexico

3.3.11.2.1 Geography

Carlsbad is located in southeastern New Mexico and is the home of New Mexico State University at Carlsbad. It is located in the Pecos Valley section of the Great Plains physiographic province and is characterized by late mature to old plains (Fenneman 1946). The immediate city area is flat and is at an elevation of 3,100 feet msl. The Pecos River drains the area. The area is part of the Tarbush-Creosote Bush section of the Chihuahuan Desert ecoregion province. Vegetation consists primarily of thorny shrubs and some short grasses (Bailey 1976). Soils are considered red desert soils typical of arid regions (Strahler 1969). Population land-area figures for 1980 show 25,952 people living on 20.5 square miles of land (Patterson 1981).

3.3.11.2.2 Land Use/Land Availability

As shown in Figure B-16 of Appendix B, urban development in Carlsbad is not heavily concentrated and reveals a pattern of interspersed cropland and pastureland (21) and shrub and brush rangeland (32). Note the prevalence of mining-related activities (75) in the southern portion of the area.

Carlsbad has been growing steadily over the past 4 years due to emphasis of being a retirement community and to energy development in the region. In addition, the Department of Energy is sponsoring a pilot waste management plant currently under construction in the Carlsbad area.

Table 3.3-73 contains the land-use/land-availability information for Carlsbad. Seventy-five percent of the total land area is developed mostly

TABLE 3.3-72

Land Values
Scottsdale, AZ

Development Category	Range	Average Cost per Acre
Residential	Low	$ 7,500
	Medium	25,000
	High	35,000
Commercial	Low	7,500
	Medium	25,000
	High	150,000
Institutional	Low	7,500
	Medium	25,000
	High	150,000

Source: Hadder 1981.

TABLE 3.3-73

Land Use/Land Availability
Carlsbad, NM

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	8,524	6,393	17-36	1,087-2,301	2,131	17-36	362-767
Commercial	671	503	34	171	168	34	57
Institutional	1,245	934	34	318	311	34	106
Other (MLU)	2,680	2,010	--	--	670	--	--
Total (city)	13,120	9,840	--	1,576-2,790	3,280	--	525-930

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	43,560	1.00	1,800	.041	6,393	155,927	2,131	51,976
Commercial[e]	6,000	.138	6,000	.138	3,645	3,645	1,217	1,217
Institutional[f]	6,000	.138	6,000	.138	6,768	6,768	2,254	2,254

Source: Patterson 1981.

[a]Data in column 2 divided by data in column 8.
[b]Data in column 2 divided by data in column 9.
[c]Data in column 5 divided by data in column 8.
[d]Data in column 5 divided by data in column 9.
[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[f]Assume minimum lot sizes are the same as commercial.

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(65 percent) for residential land uses. There are from 2,101 to 3,720 acres of PSL in Carlsbad. The zoning code permits from 6,393 to 155,927 residential units on developed land and from 3,131 to 51,976 additional units on undeveloped land. Estimates for developed commercial and institutional land are 3,645 to 6,768 units, respectively. On undeveloped land, the corresponding commercial/institutional projections are 1,217 and 2,254 units, respectively.

As shown on Table 3.3-74, there are 7,416 acres of total single family and 1,108 acres of total multifamily land in the area. Estimates for total living space include 113 million square feet of single family and 31 million square feet of multifamily space. Twenty-five percent of the square footage totals is dedicated to undeveloped city land.

3.3.11.2.3 Land Values

As Table 3.3-75 indicates, land values in Carlsbad are relatively inexpensive for undeveloped lots. Desert land without urban services is available for approximately $200 per acre. A large lot with urban services for institutional development is available for approximately $20,000 per acre. In comparison to other parts of the country, commercial land is very inexpensive. Water availability is a major development issue in the area.

3.3.11.3 Whittier, California

3.3.11.3.1 Geography

Whittier is located in southwestern California, east of Los Angeles, and is home to Whittier College. It is located in the Los Angeles Range section of the Pacific Border physiographic province. Landforms include narrow ranges and broad fault blocks and alluviated lowlands (Fenneman 1946). Vegetation is classified as belonging to the California Chaparral ecoregion province that has variable vegetation patterns that are dependent upon elevation, slope direction, and the availability of moisture (Bailey 1976). Soils are classified as red and yellow podzolic (Strahler 1969). The reported 1980 population is 68,872, and the land area is 12.1 square miles (Leslie 1981).

TABLE 3.3-74

Single Family/Multifamily Residential Data
Carlsbad, NM

Development Category	Developed Land: Total Acres	Developed Land: Single Family		Developed Land: Multifamily		Undeveloped Land: Total Acres	Undeveloped Land: Single Family		Undeveloped Land: Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	6,393	87	5,562	13	831	2,131	87	1,854	13	277

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	81,160	1,535	906	84,714,808	23,529,907	68	32	27,054	1,535	906	28,238,965	7,843,496

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-73.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-73.

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TABLE 3.3-75

Land Values
Carlsbad, NM

Development Category	Range	Average Cost per Acre
Residential	Low	$ 3,500
	Medium	5,500
	High	7,500
Commercial	Low	15,000
	Medium	25,000
	High	45,000
Institutional	Low	200[a]
	Medium	NA[b]
	High	20,000

Source: Williamson 1981.

[a]Reported value is for desert land without urban services.

[b]Not available.

3.3.11.3.2 Land Use/Land Availability

As indicated in Table 3.3-76, Whittier is 93 percent developed. Parcel assemble and steep slopes plus the present city council's no-growth attitude pose development constraints in the city. The estimates for PSL indicate that between 1,205 to 2,015 acres would be available. The zoning code permits a combined developed/undeveloped total of 12,401 to 147,103 residential units, 2,131 commercial units, and 6,615 institutional units.

Table 3.3-77 contains the single family/multifamily data. The data show 3,712 acres for total single family development and 554 acres for total multifamily development. A total of 83 million square feet of single family space and 23 million square feet of multifamily space are estimated for Whittier. Of these totals, only about 7 percent are currently projected for future development.

3.3.11.3.3 Land Values

Table 3.3-78 shows the range of land values in Whittier. The current city council in Whittier has a no-growth development policy. This attitude, in addition to a minimal amount of undeveloped land, is causing a shifting of the tax base to surrounding communities (Dotson 1981). As a result, land is expensive, with values for developed residential and institutional land ranging from $196,020 to $348,480 per acre. Commercial property is approximately twice the residential/institutional price.

3.3.11.4 Regional Summary of Cities

The highly developed characteristics of Whittier are further emphasized in Figure C-10 of Appendix C. Very little PSL is available there in the undeveloped sector (less than 140 acres). Carlsbad shows good availability of PSL in the undeveloped residential category (greater than 750 acres) but gets poor ratings for commercial and institutional applications. Scottsdale exhibits the most overall potential with more than 2,000 acres of undeveloped PSL.

TABLE 3.3-76

Land Use/Land Availability
Whittier, CA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	4,266	3,980	17-36	677-1,433	286	17-36	49-103
Commercial	343	320	34	109	23	34	8
Institutional	1,065	994	34	338	71	34	24
Other (MLU)	2,099	1,958	--	--	141	--	--
Total (city)	7,773	7,252	--	1,124-1,880	521	--	81-135

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	15,000	.344	1,250	.029	11,570	137,241	831	9,862
Commercial[e]	7,000	.161	7,000	.161	1,988	1,988	143	143
Institutional[f]	7,000	.161	7,000	.161	6,174	6,174	441	441

Source: Leslie 1981.

[a] Data in column 2 divided by data in column 8.

[b] Data in column 2 divided by data in column 9.

[c] Data in column 5 divided by data in column 8.

[d] Data in column 5 divided by data in column 9.

[e] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f] Assume minimum lot sizes are the same as commercial.

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TABLE 3.3-77

Single Family/Multifamily Residential Data
Whittier, CA

Development Category	Developed Land: Total Acres	Developed Land: Single Family Percent of Total	Developed Land: Single Family Calculated Acreage	Developed Land: Multifamily Percent of Total	Developed Land: Multifamily Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family Percent of Total	Undeveloped Land: Single Family Calculated Acreage	Undeveloped Land: Multifamily Percent of Total	Undeveloped Land: Multifamily Calculated Acreage
Residential	3,980	87	3,463	13	517	286	87	249	13	37

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	74,706	1,535	906	77,664,983	21,571,788	68	32	5,347	1,535	906	5,581,199	1,550,202

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-76.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-76.

TABLE 3.3-78

Land Values
Whittier, CA

Development Category	Range	Average Cost per Acre
Residential	Low	$196,020
	Medium	239,580
	High	348,480
Commercial	Low	392,040
	Medium	522,720
	High	653,400
Institutional	Low	196,020
	Medium	239,580
	High	348,480

Source: Dotson 1981.

Relatively low property costs are associated with Carlsbad, high costs with Whittier, and medium costs with Scottsdale, as presented in Figure D-10 of Appendix D. In analyzing both graphs (C-10 and D-10), it becomes apparent that undeveloped residential property in Carlsbad is available and represents a comparatively good buy. Scottsdale residential property also appears fairly reasonable, but commercial and institutional prices exhibit a wide range.

3.3.12 TENNESSEE VALLEY REGION

Arkansas, Delaware, Kentucky, Maryland, Missouri, North Carolina, Tennessee, Virginia, and West Virginia are the states included in the Tennessee Valley region. The cities selected for study in this region include Liberty, Missouri (low density); Roanoke, Virginia (medium density); and Columbia, Missouri (high density). Figure 3.3-11 presents the Tennessee Valley region and locates the case study cities and additional reference cities. Information concerning geography, land use/availability, and land values is presented in the following discussions.

3.3.12.1 Liberty, Missouri

3.3.12.1.1 Geography

Liberty is located in northwestern Missouri, northeast of Kansas City, and is the home of William Jewell College. It is part of the Dissected Till Plains section of the Central Lowland physiographic province and consists of submaturely to maturely dissected till plains (Fenneman 1946). The city is located at approximately 1,000 feet msl and is just north of the Missouri River. Ecologically, Liberty is in the Oak-Hickory-Bluestem Parkland section of the Prairie Parkland ecoregion province. Typical vegetation consists of forest-steppe that combines prairie, groves, and strips of deciduous trees (Bailey 1976). Soils are classified as prairie, typical of subhumid and humid grasslands. The reported 1980 population is 16,300, and the land area is 19.5 square miles (Mangan 1981).

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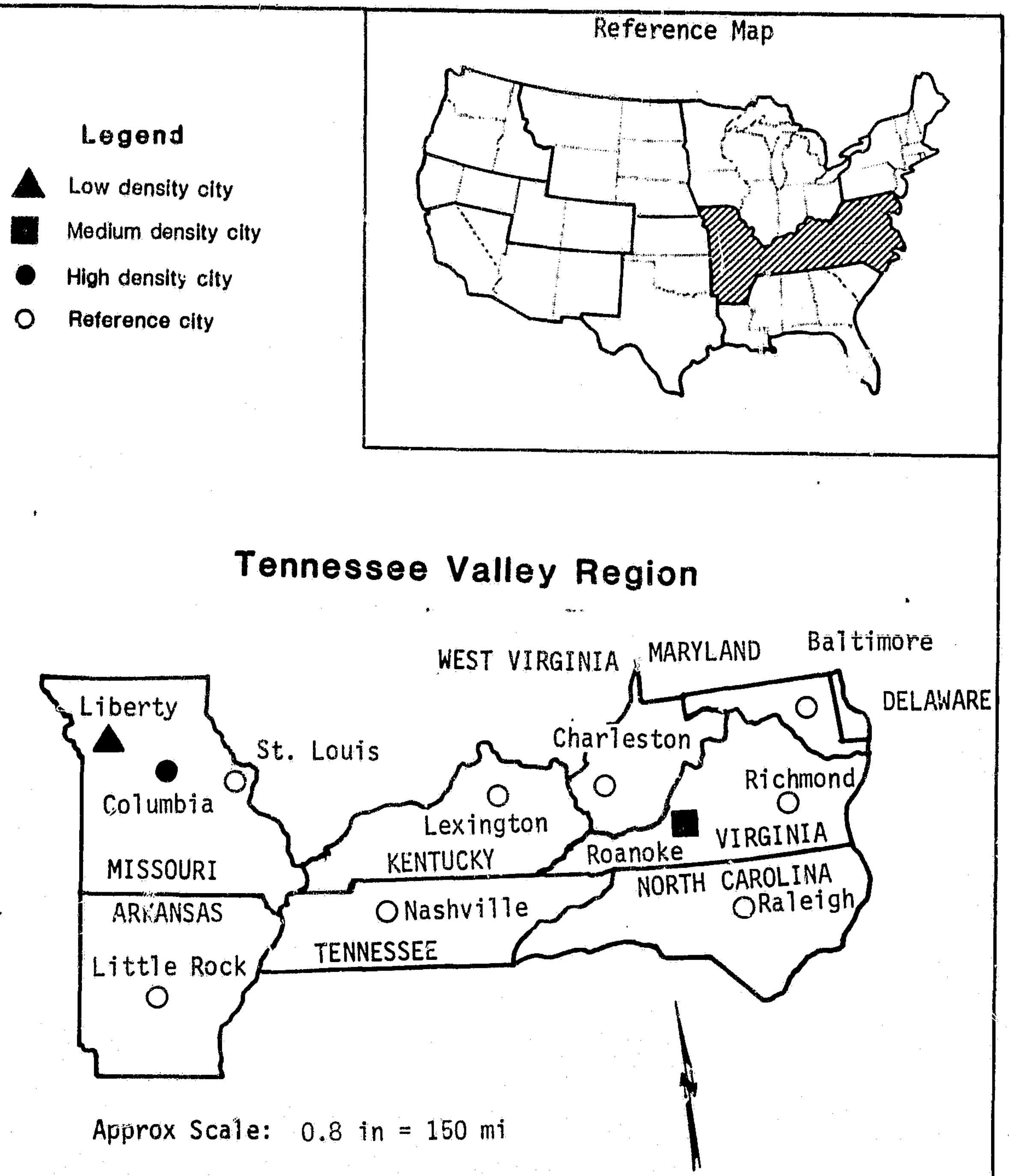

FIGURE 3.3-11

Location of Case Study Cities,
Tennessee Valley Region

3.3.12.1.2 Land Use/Land Availability

Figure B-17 of Appendix B reflects a dispersed development pattern for Liberty. The Kansas City suburban area is evident to the southwest. The majority of the open space surrounding Liberty is cropland and pastureland (21).

Liberty has always been a bedroom community for Kansas City. This has created steady residential growth over the past decade although there is a need for more commercial development within the community.

Table 3.3-79 shows that there is more undeveloped land (6,964 acres) than developed land (5,516 acres) in Liberty. Total PSL is estimated between 3,589 to 3,939 acres. The zoning code permits a maximum of 1,033 to 134,696 residential units, 4,951 commercial units, and 98 institutional units on developed land. On undeveloped land the estimates are 1,304 to 170,043 residential units, 6,250 commercial units, and 125 institutional units.

The ratio of single family to multifamily residential units is 6,098 to 911 acres, respectively, as found in Table 3.3-80. A total estimate of 160 million square feet of single family space and 44 million square feet of multifamily space has been projected. Fifty-six percent of the total square footage is potentially available on undeveloped land.

3.3.12.1.3 Land Values

Table 3.3-81 presents land-value data for Liberty. Undeveloped land in the urban fringe is available for $3,500 to $5,000 per acre. Developed residential, commercial, and institutional property is much more costly.

3.3.12.2 Roanoke, Virginia

3.3.12.2.1 Geography

Roanoke is located in western Virginia. It is in the Tennessee section of the Valley and Ridge physiographic province that is comprised of second-

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TABLE 3.3-79

Land Use/Land Availability
Liberty, MO

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	7,009	3,098	41-46	1,270-1,425	3,911	41-46	1,604-1,799
Commercial	2,061	911	34	310	1,150	34	391
Institutional	41	18	34	6	23	34	8
Other (MLU)	3,369	1,489	--	--	1,830	--	--
Total (city)	12,480	5,516	--	1,586-1,741	6,964	--	2,003-2,198

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	130,680	3.00	1,000	.023	1,033	134,696	1,304	170,043
Commercial[e]	8,000	.184	8,000	.184	4,951	4,951	6,250	6,250
Institutional[f]	8,000	.184	8,000	.184	98	98	125	125

Source: Mangan 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-80

Single Family/Multifamily Residential Data
Liberty, MO

Development Category	Developed Land: Total Acres	Developed Land: Single Family Percent of Total	Developed Land: Single Family Calculated Acreage	Developed Land: Multifamily Percent of Total	Developed Land: Multifamily Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family Percent of Total	Undeveloped Land: Single Family Calculated Acreage	Undeveloped Land: Multifamily Percent of Total	Undeveloped Land: Multifamily Calculated Acreage
Residential	3,098	87	2,695	13	403	3,911	87	3,403	13	508

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	67,865	1,535	906	70,837,487	19,675,421	68	32	85,674	1,535	906	89,426,521	24,838,606

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-79.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-79.

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TABLE 3.3-81

Land Values
Liberty, MO

Development Category	Range	Average Cost per Acre
Residential	Low	$ 3,500
	Medium	41,333
	High	72,000
Commercial[a]	Low	108,900
	Medium	239,580
	High	261,360
Institutional[a]	Low	108,900
	Medium	239,580
	High	261,360

Source: Oberfoell 1981.

[a]Undeveloped land in the urban fringe is available for $3,500 and $5,000 per acre.

cycle mountains and valley belts that predominate over even-crested ridges (Fenneman 1946). It is at an elevation of 1,100-1,200 feet msl, is surrounded by forested hills (Jefferson National Forest), and is located on the Roanoke River. The area is in the Appalachian Oak Forest section of the Eastern Deciduous Forest ecoregion province and, as previously presented, is dominated by tall broadleaf trees that provide a dense canopy and a weak understory of small trees and shrubs (Bailey 1976). Soils are classified as lithosols (Strahler 1969). Roanoke exhibited a 1980 population of 100,428, and a land area of 42 square miles (Tucker 1981).

3.3.12.2.2 Land Use/Land Availability

The land-use patterns of eastern Roanoke are shown in Figure B-18 of Appendix B. The central core appears to be heavily industrialized (13 and 15). The fringe environs have a good mixture of residential (11) and commercial (12) uses interspersed with cropland and pastureland (21) and deciduous forestland (41).

As presented in Table 3.3-82, 25 percent of Roanoke's total land area is undeveloped. Total PSL is estimated at 7,692 to 8,348 acres. The zoning code permits a potential combined total of 42,268 to 569,696 residential units, 8,646 commercial units, and 33,727 institutional units.

Table 3.3-83 contains the single family/multifamily residential data. There are an estimated 11,400 acres of single family land compared to 1,703 acres of multifamily land. It is projected that 319 million and 89 million square feet of space are potentially available for single family and multifamily use, respectively. Of these totals, 25 percent potentially exists on presently undeveloped land.

3.3.12.2.3 Land Values

Table 3.3-84 shows the land values for Roanoke. Large tracts of land for institutional use are available for between $10,000 and $20,000 per acre in the area. There are four separate governing bodies within the Roanoke Valley, and land values vary within the different communities (Kirkland

TABLE 3.3-82

Land Use/Land Availability
Roanoke, VA

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	13,103	9,817	41-46	4,025-4,516	3,28[illegible]	41-46	1,347-1,512
Commercial	1,392	1,043	34	355	349	34	119
Institutional	5,430	4,068	34	1,383	1,362	34	463
Other (MLU)	7,638	5,722	--	--	1,916	--	--
Total (city)	27,563	20,650	--	5,763-6,254	6,913	--	1,929-2,094

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	13,500	.310	1,000	.023	31,668	426,826	10,600	142,870
Commercial[e]	7,000	.161	7,000	.161	6,478	6,478	2,168	2,168
Institutional[f]	7,000	.161	7,000	.161	25,267	25,267	8,460	8,460

Source: Tucker 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

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TABLE 3.3-83

Single Family/Multifamily Residential Data
Roanoke, VA

Development Category	Developed Land: Total Acres	Developed Land: Single Family: Percent of Total	Developed Land: Single Family: Calculated Acreage	Developed Land: Multifamily: Percent of Total	Developed Land: Multifamily: Calculated Acreage	Undeveloped Land: Total Acres	Undeveloped Land: Single Family: Percent of Total	Undeveloped Land: Single Family: Calculated Acreage	Undeveloped Land: Multifamily: Percent of Total	Undeveloped Land: Multifamily: Calculated Acreage
Residential	9,817	87	8,541	13	1,276	3,286	87	2,859	13	427

Development Category	Existing Zoning for Developed Land: Unit Breakdown: Percentage SF[a]	MF[b]	Average Number of Units[c]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF	Existing Zoning for Undeveloped Land: Unit Breakdown: Percentage SF	MF	Average Number of Units[d]	Average Square Feet per Unit SF	MF	Total Square Feet SF	MF
Residential	68	32	229,247	1,535	906	239,290,000	66,463,290	68	32	76,735	1,535	906	80,095,993	22,247,011

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-82.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-82.

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TABLE 3.3-84

Land Values
Roanoke, VA

Development Category	Range	Average Cost per Acre
Residential	Low	$ 2,614
	Medium	52,707
	High	186,872
Commercial	Low	50,000
	Medium	90,000
	High	200,000
Institutional[a]	Low	10,000
	Medium	15,000
	High	20,000

Source: Kirkland 1981.

[a]Reported values are the cost per acre for a large tract of land (10 to 15 acres).

1981). Generally, land values in the county are somewhat higher than those in the city of Roanoke.

3.3.12.3 Columbia, Missouri

3.3.12.3.1 Geography

Columbia is located in central Missouri and is the home of the University of Missouri. Landforms in the area exhibit the transition from the Springfield-Salem Plateau section (submature to mature plateaus) to the Dissected Till Plains section (submaturely to maturely dissected till plains) (Fenneman 1946). Elevation is about 780 feet msl, and the city is found just north of the Missouri River. Vegetation is characteristic of the Oak-Hickory Forest section of the Eastern Deciduous Forest province, exhibiting a pattern similar to Roanoke. Soils are classified as gray-brown podzolic (Strahler 1969). The reported 1980 population is 62,061, and the land area is 42 square miles (Elliot 1981).

3.3.12.3.2 Land Use/Land Availability

Most of the development has been in the county rather than in Columbia since 1970. Columbia is a service-oriented community for the University of Missouri, but it also is trying to attract clean industry and diversity.

Table 3.3-85 indicates that 70 percent of Columbia is undeveloped land. Total PSL is between 7,666 and 8,376 acres. The maximum development permitted by the existing zoning ordinance is 88,787 to 417,823 residential units, 10,704 commercial units, and 20,785 institutional units. The institutional estimate is high because of the large amount of land used by the University of Missouri.

As presented in Table 3.3-86, there are 12,359 acres of single family land and 1,847 acres dedicated to multifamily use. This area is estimated to potentially support 264 million square feet of single family space and 73 million square feet of multifamily space. Approximately 70 percent of these

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TABLE 3.3-85

Land Use/Land Availability
Columbia, MO

Development Category	(1) Total Acres	Developed Acres (2) Total Developed Acres	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (acres)	Undeveloped Acres (5) Total Undeveloped Acres	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (acres)
Residential	14,206	4,236	41-46	1,737-1,949	9,970	41-46	4,088-4,586
Commercial	1,841	549	34	187	1,292	34	439
Institutional	3,575	1,066	34	362	2,509	34	853
Other (MLU)	7,258	2,164	--	--	5,094	--	--
Total (city)	26,880	8,015	--	2,286-2,498	18,865	--	5,380-5,878

Development Category	Prescribed Density (8) Low Minimum Lot Size (ft^2)	Acres	(9) High Minimum Lot Size (ft^2)	Acres	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[a]	(11) High (units)[b]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[c]	(13) High (units)[d]
Residential	7,000	.160	1,500	.034	26,475	124,588	62,312	293,235
Commercial[e]	7,500	.172	7,500	.172	3,192	3,192	7,512	7,512
Institutional[f]	7,500	.172	7,500	.172	6,198	6,198	14,587	14,587

Source: Elliot 1981.

[a]Data in column 2 divided by data in column 8.

[b]Data in column 2 divided by data in column 9.

[c]Data in column 5 divided by data in column 8.

[d]Data in column 5 divided by data in column 9.

[e]See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.

[f]Assume minimum lot sizes are the same as commercial.

TABLE 3.3-86

Single Family/Multifamily Residential Data
Columbia, MO

Development Category	Developed Land					Undeveloped Land				
	Total Acres	Single Family		Multifamily		Total Acres	Single Family		Multifamily	
		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage		Percent of Total	Calculated Acreage	Percent of Total	Calculated Acreage
Residential	4,236	87	3,685	13	551	9,970	87	8,674	13	1,296

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[c]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet	
	SF[a]	MF[b]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	68	32	75,532	1,535	906	78,840,302	21,898,237	68	32	177,773	1,535	906	185,560,000	51,539,948

[a]Single family.

[b]Multifamily.

[c]Obtained by averaging the data in columns 10 and 11 of the residential category in Table 3.3-85.

[d]Obtained by averaging the data in columns 12 and 13 of the residential category in Table 3.3-85.

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totals displays an estimate of the amount of square feet available for undeveloped lands.

3.3.12.3.3 Land Values

Land values for Columbia, as presented in Table 3.3-87, reflect the cost of developed land in the area. The low range for all three land uses are comparable, exhibiting a trend that is not commonly observed in this study. Overall, commercial land costs exhibit a greater range and are much higher than the more parallel trends present in the residential and institutional sectors.

3.3.12.4 Regional Summary of Cities

Pond-suitable land appears to be readily available in all three regional cities, as shown in Figure C-11 of Appendix C. Those areas revealing some deficiencies include the institutional sector of Liberty and the Roanoke commercial category. Both Liberty and Columbia exhibit an unusually high amount of undeveloped commercial PSL. Residential land is available in all cities.

Figure D-11 of Appendix D presents land-cost comparisons for the region. Commercial land is relatively expensive for all three cities, but residential land is more reasonable in Liberty and Roanoke. Overall, there appears to be a good supply of relatively inexpensive institutional land in Roanoke.

TABLE 3.3-87

Land Values
Columbia, MO

Development Category	Range	Average Cost per Acre
Residential	Low	$ 40,510
	Medium	105,850
	High	171,190
Commercial	Low	21,780
	Medium	446,490
	High	871,200
Institutional	Low	35,000
	Medium	97,500
	High	160,000

Source: Willie 1981.

4.0 REGIONAL PROJECTIONS

4.1 INTRODUCTION

The purpose of this chapter is to estimate and analyze, on a regional basis, the amount of land that is physically available for potential solar pond development in a given region for the residential, commercial, and institutional land-use categories. The data presented are a result of extensive analysis of prototype cities selected to facilitate regional interpretation. The following section describes the methodology employed in making regional projections.

4.2 METHODOLOGY

In developing regional projections, it is first necessary to calculate the total land area in each density category of a given region for all cities with a minimum population of 10,000. The original 1975 listing of cities contained in each density category within each region provided the basis for calculating the total land area in each region. For example, the respective land acreages for each city in the low-density category in the Black Hills region were added together to derive the total acreage for the low-density cities in the region.

After determination of the land area for each density category within a region, a basic methodology was applied to arrive at regional projections. The basic assumption that must be understood here is that the base data used for all the other cities in a given density category in a given region are based on the information developed from the selected prototype city. It is assumed that development patterns present in similar density-rated cities will be more parallel than any other comparable grouping system, such as population size, etc. Following is a summary of the steps employed.

> The total land area (reported in acres) for each regional density category (low, medium, high) is designated as "TLA." The number is determined by totaling the land areas of all cities in a given density category. For a working example to familiarize the reader

with the information being discussed, please see Table 4.4-1. TLA is represented by the three subtotals in column 1.

TLA is then multiplied by the percentage of developed land found in the case study (prototype) city for the given density category in a given region. This number represents the amount of developed land in that regional category and is designated "DL."

The same procedure described in step 2 is applied to determine the amount of undeveloped land within each regional density category. By multiplying the TLA by the percentage of undeveloped land in the case study city, the regional undeveloped land total is determined and is designated "UDL."

The next step involved determining the amount of developed and undeveloped land devoted or to be devoted to residential, commercial, and institutional uses in the region for each category. This number is obtained by multiplying DL and UDL by the existing percentage of those totals dedicated to residential, commercial, and institutional uses. In other words, if a given region contains 10,000 acres of developed land for the low-density category and the known percentage breakdown (derived from the prototype city) for the low-density city for residential, commercial, and institutional uses is 25, 15, and 5, respectively, the regional projection for each use would be 2,500, 1,500, and 500 acres, respectively. The numbers obtained are designated as "DA" and "UDA." The reader is referred to Table 4.4-1. DA and UDA are presented in columns 3 and 6, respectively.

As discussed in Chapter 3, a specific percentage (P) is used for each land-use category to determine the amount of pond-suitable land available in each prototype city. Residential percentages vary from region to region, whereas the commercial and institutional percentages (34 percent) remain constant across the 12 regions (Table 4.4-1, columns 4 and 7). These percentages are then multiplied by DA and UDA to derive the pond-suitable land

available for each land use within each density category for the region (Table 4.4-1, columns 5 and 8 subtotals). By totaling these pond-suitable acres for developed and undeveloped land, the total amount of pond-suitable land for each region can be determined. This number is termed "PSL." The total PSL for the developed and undeveloped categories are shown in the "Total" line of columns 5 and 8 in Table 4.4-1.

A further refinement of the general residential data is needed to determine the regional ratio of single family to multifamily development. This is determined by adding the DA and UDA residential subtotals and multiplying each separately by the 87/13 percentage split referenced in Chapter 3. The resultant estimates represent the amount of land currently dedicated or that could be dedicated to these uses. Footnote "d" of Table 4.4-1 shows a working example of this information. To determine the single family/multifamily PSL, simply multiply the respective breakdowns by the percentages shown in column 4.

Estimates were made in Chapter 3 regarding the amount of square feet available in the single family/multifamily sectors of each prototype city. It is impossible to calculate regional square footage projections due to the varying zoning ordinances and differing size of each city in a region. Therefore, regional square footage projections will not be made.

It must be again emphasized that the data presented in this report are based at times on some very general and theoretical assumptions that are employed to facilitate the regional character of this study. The more complex the analysis, the more these generalizations become overriding factors and distort the data. The reader is reminded of these assumptions solely for the purpose of trying to alleviate potential confusion that could surface in using the data for site-specific or actual real world applications. Future, more in-depth studies will be needed for site-specific determinations.

The emphasis of the regional projections presented in the following discussions is primarily on the undeveloped portions of the regional city

acreage. Comprehensive data are shown for all sectors possible, but it is felt the undeveloped areas represent the overall greatest potential in future urban design patterns and should be more closely scrutinized. In this regard, undeveloped residential land comprises the highest percentage, in most cases, and will be highlighted for both the single family and multifamily segments.

4.3 ALASKA REGION

Regional projections have not been made for the Alaska region due to the fact that only one city from this region has been studied. There are only two other cities in the region with populations greater than 10,000 -- Fairbanks and Juneau; therefore, regional analysis serves no useful purpose. The reader is referred to section 3.3-1 for the analysis of the city of Anchorage.

4.4 ATLANTIC NORTHEAST REGION

Table 4.4-1 presents a summary of the projections made for this region. As shown, almost 5.5 million acres of land are dedicated to urban uses in towns greater than 10,000. Of this total, 1.1 to 1.3 million acres (22 to 23 percent) are estimated to be pond-suitable lands, of which 511,000 to 550,000 acres (9 to 10 percent) are on undeveloped lands. The majority of the undeveloped PSL is contained in the residential category of the low-density cities (60 to 61 percent). Commercial PSL availability is minimal.

The single family/multifamily ratio estimate for the undeveloped land in the region is 1.1 million to 167,842 acres. These estimates in turn yield 359,440 to 393,138 acres and 53,709 to 58,745 acres of PSL, respectively. The developed multifamily PSL is 63,190 to 69,115 acres.

Land values in the residential sector of the region exhibit a fairly tight range, from a low of $3,049 per acre in Wilkes-Barre to $46,400 per acre in Brockton. Commercial prices range from $20,000 per acre (Derry) to $144,619 (Wilkes-Barre). Institutional land exhibits a wide price range, from a low of $1,000 per acre in Derry to a high of $90,000 per acre in Brockton.

TABLE 4.4-1

Land-Availability Projections
Atlantic Northeast Region

			Developed Land			Undeveloped Land		
Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	(3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	(6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		240,374	32-35	76,920-84,131	961,498	32-35	307,679-336,524
	Medium		1,060,029	32-35	339,209-371,010	305,311	32-35	97,700-106,859
	High		218,596	32-35	69,951-76,509	24,284	32-35	7,771-8,499
Commercial	Low		6,586	34	2,239	27,001	34	9,180
	Medium		180,619	34	61,411	51,931	34	17,657
	High		51,841	34	17,626	5,760	34	1,958
Institutional	Low		33,806	34	11,494	135,444	34	46,051
	Medium		217,142	34	73,828	62,489	34	21,246
	High		48,941	34	16,640	5,429	34	1,846
Regional Total	Low	2,195,200						
	Medium	2,853,376						
	High	414,400						
Total		5,462,976			669,318-714,888[e]			511,088-549,820[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 1,518,999. The single family/multifamily split for this total is 1,321,529 and 197,470 acres, respectively. The sum of column 6 for the residential category is 1,291,0[illegible]. The single family/multifamily split for this total is 1,123,251 and 167,842 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 1,180,406 to 1,264,708 acres of land will be available for solar pond development in towns/cities >10,000 in the Atlantic Northeast region.

While these land values are site specific, they should be fairly representative of the region since most other cities should fall within these ranges.

4.5 BLACK HILLS REGION

Cities with populations greater than 10,000 occupy 342,272 (0.34 million) acres in this region, as shown in Table 4.5-1. The amount of total PSL is estimated to be 60,192 to 77,498 acres (18 to 23 percent of the regional total). Undeveloped PSL is estimated to range from 24,892 to 31,946 acres, or 7 to 9 percent of the total land under urban jurisdiction. Fifty-seven to 67 percent of this undeveloped PSL is projected for the residential sector. The outlook for institutional land availability is much better than for commercial uses.

The projected amount of undeveloped single family land in the region is 47,205 acres, whereas 7,054 acres are potentially dedicated to multifamily uses, of which 12,273 to 18,410 acres are in the single family PSL category, and 1,834 to 2,751 acres are in the multifamily PSL class. The PSL estimate for developed multifamily uses is 2,665 to 3,998 acres.

Following is a summary of the ranges of land values, reported in cost per acre, exhibited by the case study cities in the region:

Residential: Low -- $28,000 (Omaha)
High -- $104,544 (Bozeman)

Commercial: Low -- $108,900 (Pierre and Omaha)
High -- $435,600 (Omaha)

Institutional: Low -- $12,000 (Bozeman)
High -- $435,600 (Omaha)

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TABLE 4.5-1

Land-Availability Projections
Black Hills Region

Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	Developed Land: (3) Developed Acres	Developed Land: (4) Percentage of Pond-Suitable Land[a]	Developed Land: (5) Total Acres of Pond-Suitable Land[b]	Undeveloped Land: (6) Undeveloped Acres	Undeveloped Land: (7) Percentage of Pond-Suitable Land[a]	Undeveloped Land: (8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		2,692	26-39	700-1,050	4,326	26-39	1,125-1,687
	Medium		53,066	26-39	13,797-20,696	45,205	26-39	11,753-17,630
	High		23,099	26-39	6,006-9,009	4,728	26-39	1,229-1,844
Commercial	Low		2,024	34	688	3,248	34	1,104
	Medium		8,075	34	2,746	6,879	34	2,339
	High		1,158	34	394	240	34	82
Institutional	Low		400	34	136	644	34	219
	Medium		21,919	34	7,452	18,671	34	6,348
	High		9,944	34	3,381	2,037	34	693
Regional Total	Low	48,768						
	Medium	213,632						
	High	79,872						
Total		342,272			35,300-45,552[e]			24,892-31,946[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 78,857. The single family/multifamily split for this total is 68,606 and 10,251 acres, respectively. The sum of column 6 for the residential category is 54,259. The single family/multifamily split for this total is 47,205 and 7,054 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 60,192 to 77,498 acres of land will be available for solar pond development in towns/cities >10,000 in the Black Hills region.

4.6 GREAT LAKES REGION

Table 4.6-1 depicts regional land-availability projections for this region. An estimated 4.9 million acres of land is contained in the cities with populations greater than 10,000. Total PSL estimates range from 749,159 to 873,785 acres, or 15 to 18 percent of the regional total. Undeveloped PSL estimates range from 211,954 to 246,339 acres (4 to 5 percent of total regional acreage). As expected, most of this undeveloped land will most likely be incorporated into residential uses that will account for 49 to 56 percent of total undeveloped PSL for the region. Projected commercial and institutional PSL availability is similar to each other.

Single family/multifamily undeveloped land accounts for 598,305 and 89,402 acres, respectively, of which single family PSL ranges from 89,746 to 119,661 acres and multifamily PSL estimates are from 13,410 to 17,880 acres. The PSL estimate for existing developed multifamily uses is 35,194 to 46,926 acres.

Land values (per acre) for the region are summarized as follows:

Residential: Low -- $2,000 (Oregon)
High -- $116,000 (Euclid)

Commercial: Low -- $2,000 (Oregon)
High -- $150,000 (Euclid)

Institutional: Low -- $2,000 (Oregon)
High -- $150,000 (Euclid)

4.7 GULF COAST REGION

The Gulf Coast region cities greater than 10,000 in population consist of about 3.1 million acres, as indicated on Table 4.7-1. Of this total, 21 to 22 percent is considered as PSL (661,282 to 691,210 acres). Existing undeveloped land accounts for 159,536 to 167,316 acres of the total PSL (5 percent of regional total). As has been the trend in the other regions, the

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TABLE 4.6-1

Land-Availability Projections
Great Lakes Region

			Developed Land			Undeveloped Land		
Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	(3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	(6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		271,843	15-20	40,777-54,369	106,114	15-20	15,917-21,223
	Medium		1,282,145	15-20	192,322-256,429	549,350	15-20	82,403-109,870
	High		250,842	15-20	37,626-50,168	32,243	15-20	4,837-6,449
Commercial	Low		28,507	34	9,692	10,839	34	3,685
	Medium		295,880	34	100,599	126,900	34	43,146
	High		16,941	34	5,760	2,186	34	743
Institutional	Low		18,968	34	6,449	7,262	34	2,469
	Medium		394,506	34	134,132	168,980	34	57,453
	High		28,964	34	9,848	3,826	34	1,301
Regional Total	Low	1,083,904						
	Medium	3,287,552						
	High	546,496						
Total		4,917,952			537,205-627,446[e]			211,954-246,339[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 1,804,830. The single family/multifamily split for this total is 1,570,202 and 234,628 acres, respectively. The sum of column 6 for the residential category is 687,707. The single family/multifamily split for this total is 598,305 and 89,402 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 749,159 to 873,785 acres of land will be available for solar pond development in towns/cities >10,000 in the Great Lakes region.

TABLE 4.7-1

Land-Availability Projections
Gulf Coast Region

Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	Developed Land (3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	Undeveloped Land (6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		411,482	28-30	115,215-123,445	102,911	28-30	28,815-30,873
	Medium		641,607	28-30	179,650-192,482	257,709	28-30	72,159-77,313
	High		54,279	28-30	15,198-16,284	28,383	28-30	7,947-8,515
Commercial	Low		117,566	34	39,972	29,392	34	9,993
	Medium		70,342	34	73,742	28,350	34	9,639
	High		6,831	34	2,323	3,568	34	1,213
Institutional	Low		29,392	34	9,993	7,328	34	2,492
	Medium		170,527	34	57,979	68,424	34	23,264
	High		22,572	34	7,674	11,806	34	4,014
Regional Total	Low	805,248						
	Medium	2,131,584						
	High	203,904						
Total		3,140,736			501,746-523,894[e]			159,536-167,316[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 1,107,368. The single family/multifamily split for this total is 963,410 and 143,958 acres, respectively. The sum of column 6 for the residential category is 389,003. The single family/multifamily split for this total is 338,433 and 50,570 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 661,232 to 691,210 acres of land will be available for solar pond development in towns/cities >10,000 in the Gulf Coast region.

majority of this undeveloped land will be dedicated to residential uses (68 to 70 percent). Approximately 30,000 and 20,000 acres of undeveloped land could be committed to institutional and commercial PSL uses, respectively.

The single family/multifamily split for the region for undeveloped land is 338,433 and 50,570 acres, respectively. Upon further examination, it is determined that 94,761 to 101,530 acres are considered as single family PSL and that 14,160 to 15,171 acres are potentially multifamily PSL. The developed multifamily PSL estimate is 40,308 to 43,187 acres.

Following is a summary of land values (cost per acre) for the case study cities for this region:

Residential: Low -- $2,000 (Birmingham)
High -- $22,000 (Baton Rouge)

Commercial: Low -- $20,000 (Baton Rouge)
High -- $217,800 (Birmingham)

Institutional: Low -- $10,000 (Bainbridge)
High -- $54,000 (Birmingham)

4.8 HAWAII REGION

Regional projections have not been made for the Hawaii region due to the fact that only one city (Honolulu) from this region has been analyzed. There are only eight other cities in the region with populations greater than 10,000 and some of those are suburbs of Honolulu; therefore, regional analysis serves no useful purpose. The reader is referred to section 3.3-6 for the analysis of the city of Honolulu.

4.9 PACIFIC NORTHWEST REGION

Table 4.9-1 summarizes the projections for this region. Approximately 2.2 million acres of land are committed to urban settings in those cities that have populations of more than 10,000. The total amount of PSL estimated for

TABLE 4:9-1

Land-Availability Projections
Pacific Northwest Region

Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	Developed Land (3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	Undeveloped Land (6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		158,000	25-34	39,500-53,720	147,703	25-34	36,926-50,219
	Medium		174,735	25-34	43,684-59,410	21,582	25-34	5,396-7,338
	High		23,226	25-34	5,807-7,897	23,910	25-34	5,978-8,219
Commercial	Low		34,432	34	11,707	32,179	34	10,941
	Medium		9,445	34	3,211	1,181	34	402
	High		6,550	34	1,207	6,741	34	2,292
Institutional	Low		303,128	34	103,064	284,142	34	96,608
	Medium		61,393	34	20,874	7,603	34	2,585
	High		6,240	34	2,122	6,431	34	2,187
Regional Total	Low	1,608,960						
	Medium	472,256						
	High	79,488						
Total		2,160,704			231,176-263,212[e]			163,324-180,791[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 355,961. The single family/multifamily split for this total is 309,686 and 46,275 acres, respectively. The sum of column 6 for the residential category is 193,195. The single family/multifamily split for this total is 168,080 and 25,115 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 394,500 to 444,003 acres of land will be available for solar pond development in towns/cities >10,000 in the Pacific Northwest region.

the region is from 394,500 to 444,003 acres (18 to 21 percent of regional total), of which 163,324 to 180,791 acres are potentially located on undeveloped lands (8 percent of regional total). The data for this region reveal a somewhat different trend in that over 62 percent of the total undeveloped PSL appears to be dedicated to institutional uses. This may not present a true picture since Klamath Falls, the low-density city, has a high amount of institutional uses that may distort the regional data. Commercial undeveloped PSL is minimal.

Single family uses on undeveloped lands could amount to 168,080 acres, whereas multifamily uses could equal 25,115 acres. Estimates for PSL in the undeveloped sector include 42,020 to 57,147 acres (single family) and 6,279 to 8,539 acres (multifamily). The PSL estimates for existing (developed) multifamily uses range from 11,569 to 15,734 acres.

The following presentation summarizes the range of land values (per acre) determined for the case study cities in the region:

Residential: Low -- $11,000 (Klamath Falls)
High -- $600,000 (Seattle)

Commercial: Low -- $65,340 (Klamath Falls)
High -- $6,534,000 (Seattle)

Institutional: Low -- $65,340 (Klamath Falls)
High -- $6,534,000 (Seattle)

4.10 PUERTO RICO REGION

Regional projections have not been made for the Puerto Rico region due to the fact that only one city (San Juan) from this region has been analyzed. There are few cities in the region with populations greater than 10,000 and some of those are suburbs of San Juan; therefore, regional analysis serves no useful purpose. The reader is referred to section 3.3.8 and Appendix F for the analysis of the city of San Juan.

4.11 RED RIVER REGION

Approximately 4 million acres of land in this region are occupied by cities having populations greater than 10,000 as shown in Table 4.11-1. The estimate for total PSL ranges from 754,551 to 797,171 acres, which is 19 to 20 percent of the regional acreage total. In relationship to the total PSL, 547,584 to 578,454 acres potentially exist on undeveloped lands. Fifty-three to 55 percent of the undeveloped PSL is in the residential category. Institutional PSL availability in the medium-density range of cities is a good possibility, as indicated by the data.

The total amount of estimated residential use in this region for undeveloped land is 1,028,962 acres, of which 895,197 acres is projected to be single family and 133,765 acres is potentially to be dedicated to multifamily uses. Further analysis indicates that 250,655 to 277,511 acres could be classified as single family undeveloped PSL and 37,454 to 41,467 acres as undeveloped multifamily PSL. Developed multifamily PSL has been determined to be 50,921 acres.

Following is a summary of low and high ranges of land values (per acre) for this region:

Residential: Low -- $2,500 (Liberal)
High -- $144,345 (Oklahoma City)

Commercial: Low -- $21,780 (Oklahoma City)
High -- $457,300 (Oklahoma City)

Institutional: Low -- $8,000 (Liberal)
High -- $457,300 (Oklahoma City)

4.12 SALT LAKE REGION

Analysis of the data indicate that 780,864 (0.78 million) acres of land are dedicated to urban settings in the Salt Lake region for all towns with populations greater than 10,000. Table 4.12-1 reveals the land-availability

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TABLE 4.11-1

Land-Availability Projections
Red River Region

			Developed Land			Undeveloped Land		
Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	(3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	(6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		95,682	28-31	26,791-29,661	280,005	28-31	78,401-86,802
	Medium		275,124	28-31	77,035-85,288	743,852	28-31	208,279-230,594
	High		20,891	28-31	5,849-6,476	5,105	28-31	1,492-1,583
Commercial	Low		15,740	34	5,352	46,184	34	15,703
	Medium		39,303	34	13,363	106,266	34	36,130
	High		4,450	34	1,513	1,092	34	371
Institutional	Low		19,571	34	6,654	57,264	34	19,470
	Medium		204,377	34	69,488	552,576	34	187,576
	High		2,172	34	922	663	34	225
Regional Total	Low	1,035,520						
	Medium	2,911,360						
	High	83,968						
Total		4,030,848			206,967-218,717[e]			547,584-578,454[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 391,697. The single family/multifamily split for this total is 340,776 and 50,921 acres, respectively. The sum of column 6 for the residential category is 1,028,962. The single family/multifamily split for this total is 895,197 and 133,765 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 754,551 to 797,171 acres of land will be available for solar pond development in towns/cities >10,000 in the Red River region.

TABLE 4.12-1

Land-Availability Projections
Salt Lake Region

Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	Developed Land: (3) Developed Acres	Developed Land: (4) Percentage of Pond-Suitable Land[a]	Developed Land: (5) Total Acres of Pond-Suitable Land[b]	Undeveloped Land: (6) Undeveloped Acres	Undeveloped Land: (7) Percentage of Pond-Suitable Land[a]	Undeveloped Land: (8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		13,499	28-37	3,780-4,995	16,316	28-37	4,569-6,037
	Medium		236,253	28-37	66,151-87,414	26,208	28-37	7,338-9,697
	High		62,258	28-37	21,168-23,036	8,288	28-37	2,321-3,067
Commercial	Low		1,772	34	603	2,144	34	729
	Medium		85,975	34	29,232	9,548	34	3,246
	High		3,664	34	1,246	493	34	168
Institutional	Low		19,770	34	6,722	23,898	34	8,125
	Medium		42,868	34	14,575	5,251	34	1,785
	High		5,950	34	2,023	796	34	271
Regional Total	Low	177,152						
	Medium	477,376						
	High	126,336						
Total		780,864			145,500-169,846[e]			28,552-33,125[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 312,010. The single family/multifamily split for this total is 271,449 and 40,561 acres, respectively. The sum of column 6 for the residential category is 50,812. The single family/multifamily split for this total is 44,206 and 6,606 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 174,052 to 202,971 acres of land will be available for solar pond development in towns/cities >10,000 in the Salt Lake region.

projections for this region. The estimated total PSL ranges from 174,052 to 202,971 acres (22 to 26 percent of total acreage). Undeveloped PSL estimates range from 28,552 to 33,125 acres, or about 4 percent of the total acreage under the jurisdiction of city governments. Fifty to 57 percent of the undeveloped PSL potentially exists in the residential category.

The single family/multifamily split for undeveloped land is 44,206 and 6,606 acres, respectively. In terms of potential undeveloped PSL, 12,378 to 16,356 acres are available for single family use and 1,850 to 2,444 acres are available for multifamily use. The developed multifamily PSL estimate is 11,357 to 15,000 acres.

Land prices in the region are quite varied. A summary of the low- and high-categorical ranges follows (cost per acre):

Residential: Low -- $29,000 (Durango)
High -- $290,000 (Durango)

Commercial: Low -- $155,000 (Carson City)
High -- $653,400 (Durango)

Institutional: Low -- $20,000 (Davis)
High -- $525,000 (Carson City)

4.13 SOUTH WEST REGION

A little more than 3 million acres of land in this region are dedicated to cities with populations greater than 10,000. Table 4.13-1 presents the land-availability projections for the South West region. A wide range of PSL is estimated for the region (452,834 to 829,086 acres) that consists of 15 to 27 percent of the total regional city acreage. The amount of undeveloped PSL is estimated to range from 103,897 to 218,229 acres, or 3 to 7 percent of the total city acreage in the region. The predominant potential application of PSL will be in the undeveloped sectors of these cities, where 67 to 68 percent of the PSL is in the residential category.

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TABLE 4.13-1

Land-Availability Projections
South West Region

Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	Developed Land (3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	Undeveloped Land (6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		217,135	17-36	36,913-78,169	61,060	17-36	10,380-21,982
	Medium		1,022,192	17-36	173,773-367,989	340,661	17-36	57,912-122,638
	High		139,199	17-36	23,664-50,112	10,032	17-36	1,705-3,612
Commercial	Low		30,822	34	10,480	8,671	34	2,948
	Medium		80,341	34	27,316	26,850	34	9,129
	High		11,201	34	3,808	815	34	1,295
Institutional	Low		30,530	34	10,380	8,161	34	2,775
	Medium		149,354	34	50,780	49,715	34	16,903
	High		34,772	34	11,823	2,501	34	850
Regional Total	Low	728,640						
	Medium	2,097,664						
	High	271,872						
Total		3,098,176			348,937-610,857[e]			103,897-218,229[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 1,378,526. The single family/multifamily split for this total is 1,199,318 and 179,208 acres, respectively. The sum of column 6 for the residential category is 411,753. The single family/multifamily split for this total is 358,225 and 53,528 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 452,834 to 829,086 acres of land will be available for solar pond development in towns/cities >10,000 in the South West region.

It is estimated that 358,225 and 53,528 acres of single family and multifamily uses, respectively, will be potentially available in the region. Undeveloped PSL range estimates for the single family and multifamily sectors include 60,898 to 128,961 and 9,099 to 19,270 acres, respectively. The PSL determination for existing developed multifamily use ranges from 30,465 to 64,515 acres.

Following is a summary of the land-value ranges (cost per acre) as determined by an analysis of the case study cities for the region:

Residential: Low -- $3,500 (Carlsbad)
High -- $348,480 (Whittier)

Commercial: Low -- $7,500 (Scottsdale)
High -- $653,400 (Whittier)

Institutional: Low -- $200 (Carlsbad)
High -- $348,480 (Whittier)

4.14 TENNESSEE VALLEY REGION

Cities in this region having populations greater than 10,000 encompass over 3.6 million acres, as identified in Table 4.14-1. The estimated total PSL for this region is about 1.1 million acres, or 30 percent of total city acreage. The undeveloped PSL acreage range is from 375,369 to 399,945 acres, or 10 to 11 percent of the total city acreage. Once again, the residential segment of this undeveloped PSL comprises most of the land (54 to 57 percent), but there seems to be a heretofore uncharacteristically large percentage available for commercial use (33 to 36 percent).

The potential single family/multifamily breakdown for the undeveloped land is 427,640 and 63,900 acres, respectively. Further analysis indicated that 175,332 to 196,714 acres are potentially dedicated to single family PSL and 26,199 to 29,394 acres could be committed to multifamily PSL. Regarding existing developed multifamily uses, 58,965 to 66,155 acres could conceivably be available as PSL.

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TABLE 4.14-1

Land-Availability Projections
Tennessee Valley Region

Development Category	(1) City Density Category	(2) Total Acres for Cities >10,000	Developed Land (3) Developed Acres	(4) Percentage of Pond-Suitable Land[a]	(5) Total Acres of Pond-Suitable Land[b]	Undeveloped Land (6) Undeveloped Acres	(7) Percentage of Pond-Suitable Land[a]	(8) Total Acres of Pond-Suitable Land[c]
Residential[d]	Low		299,460	41-46	122,779-137,752	378,126	41-46	155,032-173,938
	Medium		770,122	41-46	315,750-354,256	111,242	41-46	45,609-51,171
	High		36,694	41-46	15,045-16,879	2,172	41-46	891-999
Commercial	Low		88,077	34	29,946	257,716	34	87,623
	Medium		81,725	34	27,787	27,458	34	9,336
	High		4,750	34	1,615	106,805	34	36,314
Institutional	Low		1,689	34	574	86,381	34	29,370
	Medium		319,118	34	108,500	11,199	34	3,808
	High		9,243	34	3,143	21,723	34	7,386
Regional Total	Low	1,206,528						
	Medium	2,162,048						
	High	232,832						
Total		3,601,408			625,139-680,452[e]			375,369-399,945[e]

[a]Percentage obtained via methodology described in section 3.2.

[b]Obtained by multiplying column 3 by column 4.

[c]Obtained by multiplying column 6 by column 7.

[d]The sum of column 3 for the residential category is 1,106,276. The single family/multifamily split for this total is 962,460 and 143,816 acres, respectively. The sum of column 6 for the residential category is 491,540. The single family/multifamily split for this total is 427,640 and 63,900 acres, respectively. This is based on the assumption that the national average for the single family/multifamily breakdown is 87 and 13 percent, respectively (Chapin and Kaiser 1979).

[e]The sum of the two totals presented reflects that 1,000,508 to 1,080,397 acres of land will be available for solar pond development in towns/cities >10,000 in the Tennessee Valley region.

A summary of the range of regional land values (cost per acre) follows:

Residential: Low -- $2,614 (Roanoke)
High -- $186,872 (Roanoke)

Commercial: Low -- $21,780 (Columbia)
High -- $871,200 (Columbia)

Institutional: Low -- $10,000 (Roanoke)
High -- $261,360 (Liberty)

4.15 SUMMARY

In general, approximately 7 to 8 percent of the land in the continental United States that is within the jurisdiction of cities having more than 10,000 people can be considered as undeveloped PSL. The Red River region maintains the highest percentage (12), followed closely by the Tennessee Valley (10 to 11 percent) and Atlantic Northeast (9 to 10 percent) regions. Those regions on the lower end of the spectrum include the South West (3 to 7 percent), Salt Lake (4 percent), and Great Lakes (4 to 5 percent).

Of this total undeveloped PSL in the United States, about 60 percent is potentially committed to residential uses. Leading the way is the Gulf Coast region (68 to 70 percent), while the South West and Atlantic Northeast regions maintain 67 to 68 and 60 to 61 percent, respectively. The Great Lakes region reflects a residential percentage of 49 to 56 that is the lowest reasonable percentage presented. The Pacific Northwest exhibits only a 30-percent residential makeup of undeveloped PSL, but as previously mentioned, these data may be distorted due to the high percentage of institutional land in Klamath Falls, Oregon. Undeveloped commercial PSL in general maintains a relatively low percentage, although the Tennessee Valley region shows 36-percent potentially dedicated to commercial uses.

5.0 REGIONAL COMPARISONS

5.1 INTRODUCTION

This chapter is designed to summarize and evaluate the significant data that have been previously presented in this report. This report contains a tremendous amount of raw data that has been refined to various levels of detail for the sole purpose of making the desired regional projections. By generally characterizing each region, the reader should now have a basic understanding and knowledge of the terminology, regional definitions and boundaries, the methodologies employed in selecting case study cities and analyzing the data, the basic physical and social characteristics of the regions and cities, and a specific definition of city and regional land use, land availability, and land values.

The following sections will put into perspective the overall goal of this study -- to define, tabulate, analyze, summarize, and compare the regional trends that have been established throughout the report. These trends (the reader is reminded that the data presented are based on numerous assumptions that allow for trend analysis) will assist the Jet Propulsion Laboratory (JPL) in their ongoing studies to evaluate solar pond applicability in the United States. This report represents just one of many analyses that are currently being undertaken by JPL.

5.2 LAND USE AND LAND AVAILABILITY

Residential, commercial, and institutional land uses have been analyzed to the greatest extent possible based on the time, scope, and purpose of this study. Through the evolution of this project and the inherent analyses that have taken place, it should now be relatively clear that potentially the most realistic application of the solar pond technology for thermal uses will be associated with future development on the existing undeveloped parcels of land. The various applications could be incorporated into future community planning activities and urban design. While retrofit uses on developed lands are still viable and still hold a place in this technology,

the general attractiveness of them are partially diminished by their site specificity and the political and social limits placed on retrofit application. Therefore, the emphasis of this analysis will be to closely examine the undeveloped sectors of the regions. Should the reader wish to pursue a similar in-depth analysis of the developed segments, it is noted that the data are presented in this report in their entirety and can be examined to the extent desired by reviewing and extracting the information from the various tables.

Table 5.2-1 compares, by region, the total amount of city acreage for cities greater than 10,000, the total pond-suitable land (PSL), the total undeveloped PSL, and the total undeveloped residential PSL as divided into single family and multifamily segments. Alaska, Hawaii, and Puerto Rico have been excluded from regional comparisons due to insufficient data. The three regions exhibiting the most total city acreage from highest to lowest are the Atlantic Northeast, the Great Lakes, and the Red River. The smallest region is the Black Hills, whose .34 million acres represent only about 16 percent of the largest region.

Total PSL includes the combined estimate for developed and undeveloped lands. Again, the Atlantic Northeast maintains the number one ranking but is followed closely by the Tennessee Valley and Red River regions. The Black Hills region is again the smallest, consisting of only 5 to 6 percent of the total PSL acreage present in the Atlantic Northeast.

Undeveloped PSL is the total amount of land that could potentially and realistically be set aside for solar pond application in the yet to be developed portions of urban settings within a region. The Red River region heads the list with the most undeveloped PSL, with the Atlantic Northeast and Tennessee Valley regions second and third, respectively. As before, the Black Hills region is at the bottom of the list with the lowest total of undeveloped PSL.

Residential land is conveniently divided into single family and multifamily segments. As previously discussed (Chapter 3), a national average has been used to determine the single/multifamily split -- 87 percent of the land use is single family; 13 percent is multifamily. In the undeveloped single

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TABLE 5.2-1

Comparison of Regional Land Use and Land Availability
Total Values and Residential Data

Region	Total City Acreage		Total PSL[b]		Undeveloped PSL		Undeveloped Single Family/Multifamily PSL			
	Millions of Acres	Rank[a]	Acres	Rank[a]	Acres	Rank[a]	SF[c] Acres	MF[d] Acres	SF Rank[a]	MF Rank[a]
Alaska	--	--	--	--	--	--	--	--	--	--
Atlantic Northeast	5.50	1	1,180,406-1,264,708	1	511,000-550,000	1	[illegible],440-393,138	53,709-58,745	1	1
Black Hills	0.34	9	60,192-77,498	9	24,892-31,946	9	12,273-18,410	1,834-2,751	8	9
Great Lakes	4.90	2	749,158-813,785	4	211,954-246,339	4	89,746-119,661	13,410-17,880	4	5
Gulf Coast	3.10	5	661,282-691,210	5	159,536-167,316	6	14,761-101,530	14,160-15,171	7	4
Hawaii	--	--	--	--	--	--	--	--	--	--
Pacific Northwest	2.20	7	394,500-444,003	7	163,324-180,791	5	42,020-57,147	6,279-8,539	6	7
Puerto Rico	--	--	--	--	--	--	--	--	--	--
Red River	4.00	3	754,5[illegible]-797,171	3	547,584-578,454	2	250,655-277,511	37,454-41,467	2	3
Salt Lake	0.78	8	174,052-202,971	8	28,552-33,125	8	12,378-16,356	1,850-2,444	9	8
South West	3.00	6	452,834-829,086	6	103,897-218,229	7	60,898-128,961	9,099-19,270	5	6
Tennessee Valley	3.60	4	1,000,508-1,080,397	2	375,369-399,945	3	[illegible]5,332-196,714	26,199-29,394	3	2

[a]Highest to lowest.

[b]Pond-suitable land.

[c]Single family.

[d]Multifamily.

family/multifamily PSL category the Atlantic Northeast again is the leader with the most single family/multifamily land potentially available. The Red River region ranks second in the single family market and third in the multifamily area, whereas the Tennessee Valley region ranks third and second, respectively, in those two categories. The smallest amount of single family/multifamily PSL is in the Salt Lake and Black Hills regions. These two regions rank either 8 or 9 in this analysis.

Table 5.2-2 depicts regional totals and comparisons of the undeveloped commercial and institutional PSL. Regarding commercial lands, the Tennessee Valley region potentially has available the most land for commercial development, with the Red River and Great Lakes a distant second and third respectively. The Black Hills region is again the lowest. Potential institutional development seems to be most attractive in the Red River, the Pacific Northwest, and the Atlantic Northeast regions, respectively.

An overall visual perspective of the phenomena described in the previous paragraphs is presented in Figure E-1 of Appendix E. This graph reflects the data shown in Tables 5.2-1 and 5.2-2 and enables the reader to better compare the results. The dominance of the Atlantic Northeast and Tennessee Valley regions in the total PSL category is evident. In the undeveloped residential (single family/multifamily) PSL class, the Atlantic Northeast, Red River, and Tennessee Valley regions lead the rankings. Trends exhibited in the undeveloped commercial and institutional PSL categories are quite discernible.

Table 5.2-3 summarizes the residential square footage estimates for each city as presented in Chapter 3. Regional analysis of the square footage available is not practical, but comparisons can be made among the cities. The developed land classification column presents the theoretical amount of square foot space that might be available in each city for retrofit applications of solar ponds. For existing single family and multifamily developments, Honolulu, Birmingham, Omaha, San Juan, and Oklahoma City rank 1, 2, 3, 4, and 5, respectively, regarding the highest square footage totals. Bozeman and Liberal have the least amount for both uses.

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TABLE 5.2-2

Comparison of Regional Land Use and Land Availability
Commercial and Institutional Data

Region	Undeveloped Commercial PSL[a]		Undeveloped Institutional PSL	
	Acres	Rank[b]	Acres	Rank[b]
Alaska	--	--	--	--
Atlantic Northeast	28,795	4	69,143	3
Black Hills	3,525	9	7,260	9
Great Lakes	47,574	3	61,223	4
Gulf Coast	20,845	5	29,770	6
Hawaii	--	--	--	--
Pacific Northwest	13,635	6	101,378	2
Puerto Rico	--	--	--	--
Red River	52,204	2	207,271	1
Salt Lake	4,143	8	10,181	8
South West	13,372	7	20,528	7
Tennessee Valley	133,273	1	40,564	5

[a]Pond-suitable land.

[b]Highest to lowest.

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TABLE 5.2-3

Comparison Square Footage Estimates
Case Study Cities

Region	City/State	Developed Land[a] SF[b]	Rank[c]	MF[d]	Rank[c]	Undeveloped Land[a] SF	Rank[c]	MF	Rank[c]
Alaska	Anchorage, AK	379	7	105	7	738	2	205	3
Atlantic Northeast	Brockton, MA	33	23	15	19	9	22	3	20
	Derry, NH	30	25	8	23	119	10	33	9
	Wilkes-Barre, PA	43	21	12	21	5	25	1	22
Black Hills	Bozeman, MT	11	29	3	25	9	22	3	20
	Omaha, NB	1,062	3	295	3	217	7	60	7
	Pierre, SD	16	28	4	24	25	19	7	18
Great Lakes	Euclid, OH	173	13	102	8	22	20	13	14
	Madison, WI	196	12	55	13	84	12	23	11
	Oregon, OH	47	20	13	20	18	21	5	19
Gulf Coast	Bainbridge, GA	329	8	91	9	82	13	23	11
	Baton Rouge, LA	229	10	64	11	120	9	33	9
	Birmingham, AL	1,260	2	350	2	506	4	141	5
Hawaii	Honolulu, HI	2,344	1	1,384	1	499	5	294	2
Pacific Northwest	Klamath Falls, OR	31	24	9	22	3	26	8	17
	Pendleton, OR	42	22	12	21	43	16	12	15
	Seattle, WA	680	6	189	6	84	12	23	11
Puerto Rico	San Juan, PR	988	4	278	4	589	3	166	4
Red River	Liberal, KS	11	29	3	25	3	26	0.8	24
	Oklahoma City, OK	853	5	237	5	2,497	1	693	1
	Waco, TX	102	14	28	14	276	6	77	6
Salt Lake	Carson City, NV	22	27	9	22	39	17	11	16
	Davis, CA	63	19	18	18	8	23	2	21
	Durango, CO	29	26	8	23	3	26	0.9	23
South West	Carlsbad, NM	85	15	24	15	28	18	8	17
	Scottsdale, AZ	205	11	57	12	58	15	16	13
	Whittier, CA	78	17	22	16	6	24	2	21
Tennessee Valley	Columbia, MO	79	16	22	16	186	8	52	8
	Liberty, MO	71	18	20	17	89	11	25	10
	Roanoke, VA	239	9	66	10	80	14	22	12

[a]Square footage expressed in millions of square feet.

[b]Single family.

[c]Highest to lowest.

[d]Multifamily.

The undeveloped land classification reflects the theoretical amount of square feet that could potentially be constructed in the presently undeveloped segments of each city. Those cities exhibiting the most single family potential in decreasing order include Oklahoma City, Anchorage, San Juan, Birmingham, and Honolulu. The lower end of the spectrum finds Durango, Klamath Falls, and Liberal.

Oklahoma City, Honolulu, Anchorage, San Juan, and Birmingham (in sequential order) show the most potential square feet for future multifamily uses. Liberal, Durango, and Wilkes-Barre have the lowest rankings in the multifamily sector.

5.3 LAND VALUES

5.3.1 NATIONAL TRENDS

Land-value data are difficult to obtain and evaluate because of the variety of sources from which they originate. Statistics, by nature, when examined closely, will usually present some inconsistencies and varied degrees of accuracy (Hoyt 1981). Determining land values is difficult and open to individual interpretation. Other factors that influence these data include the following (Homer Hoyt Institute 1981):

- Demand variations for land;
- Topography and local geography;
- Zoning;
- Availability of urban services; and
- Availability of utilities.

The three principal items affecting housing production include land, residential construction costs, and financing. These three items all increased significantly in the 1970s at a higher rate than the 1960s (Miller 1981). A developed lot in today's market is now responsible for 20 to 30 percent of the actual cost of a single family house (FHA financed). A recent survey undertaken by the Urban Land Institute (ULI) indicates that residential land prices are continuing to increase rapidly, far exceeding the rates of consumer price increases (Miller 1981). This regional study

of the United States, which divided the country into three regions (North, South, and West), indicates a large range of price increases across regions, especially in the western cities -- Phoenix, Boulder, Seattle, and San Diego (Miller 1981).

Land-price inflation is affected by three basic factors -- supply forces, demand forces, and future expectations of supply and demand. Those forces of supply include limits on developable land supplies, more site development requirements, and approval process delays. Demand forces include a large and strong housing demand caused by population movement and the recent invasion of the housing market by the baby boom generation. The third factor, future expectations, concerns land investments that are attractive in the speculative market in areas where increasing housing demand and rising land prices are proven commodities (Miller 1981).

The 1980 ULI survey characterizes residential land-price increases as mild in the South (Atlanta, Miami, Jacksonville, and Houston), steady in the North (Pittsburgh, Hartford, Kansas City, and Indianapolis), and accelerating in the West. In general, the survey indicates inflated residential land values are primarily influenced by the demand for new housing, higher development costs, and constraints on the supply of developable land (Miller 1981).

A recent (August 1981) projection by the Homer Hoyt Institute (HHI) indicates that in the near future (12 to 24 months) land prices will stabilize due to slow housing sales and bankruptcies. HHI states that as inflation comes down, land quickly becomes an overrated investment.

Exhibit A of Appendix E summarizes the average size of finished residential lots by states for the period 1976 to 1980, and Exhibit B reflects the cost of finished residential lots by states and the average cost of finished residential lots per square foot for the same period. These data indicate that the average cost for a finished residential lot for 1980 was $13,539, based upon 12,807 square feet per lot ($1.05 per square foot). Hawaii exhibits the most expensive lots ($62,516 per 5,901-square foot lot) with California rated as the second most expensive ($30,853 on an 8,378-square foot lot). Large lots are representative of the New England states (Maine --

42,168 square feet), and small lots are most common in the west (Hawaii -- 5,901, Nevada -- 7,352 square feet, Alaska -- 8,071 square feet, and California -- 8,378 square feet).

Exhibit C of Appendix E shows a land-price index for different portions of the country based on a monthly analysis. Increases in all regions are easily traced since 1979. The increases in the Northeast have been steady and minimal, whereas the South and West exhibit steady but high increases. The lower chart of exhibit C compares the cost per acre of residential land from 1971 to 1980.

5.3.2 SOLAR POND EVALUATION

Table 5.3-1 presents an overall summary of the results of this study. As previously expressed, land values are difficult to obtain and are not easily compared due to the many variables involved. Based on the city-specific research of these data, the lowest residential land prices are potentially available in the Gulf Coast, Great Lakes, Red River, and Tennessee Valley regions ($2,000 to $2,614 per acre). In the commercial sector, the Great Lakes and South West rank one and two, respectively, concerning the lowest potential costs based on ranges of values. Institutional prices are quite variable, but low prices are evident in the South West, Atlantic Northeast, and Great Lakes regions.

Figure E-2 of Appendix E graphically summarizes the regional trends displayed by this study. In general, it easily is seen that land values in those areas west of the Mississippi River reflect a higher level than those areas east of the Mississippi River. These results concur with the results of the ULI and HHI studies. High values are very evident in the Pacific Northwest, Black Hills, Salt Lake, South West, Red River, and the Tennessee Valley regions.

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TABLE 5.3-1

Comparison of Regional Land Values

Region	Residential[a] Low	Rank[b]	High	Rank[b]	Commercial[a] Low	Rank[b]	High	Rank[b]	Institutional[a] Low	Rank[b]	High	Rank[b]
Alaska[c]	$4,000	--	$25,000	--	$217,800	--	$1,742,000	--	$217,800	--	$1,742,000	--
Atlantic Northeast	3,049	4	46,000	2	20,000	3	144,619	1	1,000	2	90,000	2
Black Hills	28,000	7	104,544	3	108,900	6	435,600	4	12,000	6	435,600	6
Great Lakes	2,000	1	116,000	5	2,000	1	150,000	2	2,000	3	150,000	3
Gulf Coast	2,000	1	22,000	1	20,000	3	217,800	3	10,000	5	54,000	1
Hawaii[c]	261,360	--	1,176,120	--	348,480[d]	--	--	--	348,480[d]	--	--	--
Pacific Northwest	11,000	6	600,000	9	65,340	5	6,534,000	8	65,340	8	6,534,000	9
Puerto Rico[c]	80,000	--	240,000	--	120,000	--	240,000	--	120,000	--	240,000	--
Red River	2,500	2	114,345	4	21,780	4	457,300	5	8,000	4	457,300	7
Salt Lake	29,000	8	290,000	7	155,000	7	653,400	6	20,000	7	525,000	8
South West	3,500	5	348,480	8	7,500	2	653,400	6	200	1	348,480	5
Tennessee Valley	2,614	3	186,872	6	21,780	4	871,200	7	10,000	5	261,360	4

[a]Reported as cost per acre, with the exception of Puerto Rico where costs are per cuerda (0.97 acre).

[b]Lowest to highest.

[c]Not ranked; data analyzed for only one city.

[d]Medium value.

6.0 CONCLUSIONS

1. This study is characterized by its comprehensive regional approach. It was determined early in the process that defining regional characteristics was more important than emphasizing the patterns of a few isolated cities and making generalizations from those data.

2. In relation to time, work scope, and the purpose of this project, a methodology was developed and employed to select and analyze the cities to be studied in the report. The general methodology involved categorizing regional cities into low-, medium-, and high-density population classes; randomly (with some evaluation of other criteria) selecting three cities from each region; collecting pertinent land-use/land-availability and land-value data; interpreting and analyzing these data; making regional projections; and summarizing and evaluating the available information. There may be more refined methods of analysis, for specific applications, but for the purpose of this study and the general analysis required, it is felt that the methodology used is more than adequate.

3. As emphasized throughout the report, numerous assumptions have been employed to allow the various analyses to proceed as smoothly as possible. Discussion of some of the more important assumptions follow:

All cities identified within a regional density category are assumed to have similar or parallel development patterns. Undeveloped land will develop in a similar pattern to the existing developed land.

Development within a city has the option of proceeding to the maximum extent dictated in the zoning ordinance, to the minimum level allowed, or to some level in between. It is likely most cities will develop between the maximum and minimum although greater weight might be given to the minimum in many cities. Determining the exact density of development is difficult without performing site-specific analysis. In

regard to the number of building units in a city, an estimate was determined by averaging the minimum and maximum values. The resultant number is strictly theoretical and has a tremendous impact on square foot estimates. National percentages and averages were used in the square footage analysis for each city. Regional data would probably have been more useful in the regional applications, but in the end the results would be similar. Correlating existing literature and regions defined therein with the regions defined in this study is a difficult task.

4. One of the comparisons made throughout the study is the distinction between developed and undeveloped land. In general, low-density cities have a higher percentage of undeveloped land than high-density cities, but that does not necessarily mean that the low-density city will have more undeveloped land. A large city with a low percentage of undeveloped land could reflect more available land than a small city with a high percentage.

5. A retrofit technology is needed to adapt solar ponds for use in developed areas. With early input into the planning process, solar pond technology can be readily coordinated for use on undeveloped land.

6. Pond-suitable land (PSL) is a concept introduced in this report that refers to the amount of land, as dictated by city zoning ordinances, that could potentially be utilized in solar pond applications, including retrofit and future. For example, in an existing single family residential development, the PSL would include all the land dedicated to rear yard space. Pond-suitable land applications are varied and can be generalized (total regional PSL) or refined (undeveloped multifamily PSL) to the extent desired.

7. The data presented in this report can be analyzed in a variety of ways and applied to numerous situations. The data base is very comprehensive and is tabulated in its entirety. The analysis has focused on the undeveloped lands within the prototype cities and the associated PSL. The application

of solar pond technology to undeveloped portions of a city is a viable and realistic alternative (from a land-use planning perspective).

8. Table 6.0-1 summarizes the overall results of the regional analysis comparisons by showing the top three ranking cities in each category. Initially, it may be surprising to note the number of times the eastern regions dominate the categories. Further investigation indicates that these regions are older (historically) and more established from a development perspective and have a much higher density of cities and, therefore, more land area. In applying the various percentage analyses, the higher the number of total acres, the greater the potential for high results. Overall, the Red River region exhibits the highest percentage of undeveloped PSL (12 percent).

9. Although the eastern regions predominantly show the highest raw numbers, the western regions still show the most potential due to a variety of factors. Appendix B presents the land-use/land-cover maps for 18 of the 30 cities. In the western regions, the land surrounding the cities is predominantly open and uncongested. Raw undeveloped land is readily available, is easily accessible, and is ripe for annexation. Topography and vegetation are better suited to development opportunities. With the increased pursuit of natural resources for energy development west of the Mississippi River and the attractiveness of the western sunbelt, economic and demographic changes in the western regions are potentially dynamic. These changes result in growth, bolstered economies, and changes in planning philosophies. Annexation becomes a major issue and towns/cities begin to expand. This continued trend will make the western regions a more attractive area for future solar pond development.

10. Collecting consistent and valid land-value data is a problem. Sources of information vary, and the presentation and type of data are inconsistent. Differing interpretations of terms (undeveloped land, raw land, etc.) lead to many data variables. Data presented in this report exhibit a wide range because land costs are as low as $200 per acre (Carlsbad -- institutional) and as high as $6 million (Seattle -- commercial). Trends revealed in this

TABLE 6.0-1

Total Acreage and Pond-Suitable
Land Ranking Summary

Category	Rank	Region
Total acreage	1	Atlantic Northeast
	2	Great Lakes
	3	Red River
Total PSL[a]	1	Atlantic Northeast
	2	Tennessee Valley
	3	Red River
Undeveloped PSL	1	Red River
	2	Atlantic Northeast
	3	Tennessee Valley
Undeveloped residential PSL	1	Red River
	2	Atlantic Northeast
	3	Tennessee Valley
Undeveloped commercial PSL	1	Tennessee Valley
	2	Red River
	3	Great Lakes
Undeveloped institutional PSL	1	Red River
	2	Pacific Northwest
	3	Atlantic Northeast

[a]Pond-suitable land.

report are consistent with recent land value surveys conducted by the Urban Land Institute and the Homer Hoyt Institute. Cost of land west of the Mississippi River is generally higher and is increasing at a fairly rapid rate. This is attributed to population migrations and the renewed interest in the United States' natural resources to supplement the nation's increased energy demand.

11. Overall, the undeveloped portions of cities present the best opportunity for application of solar pond technology. The potential is greatest in those areas where coordinated planning takes place in the early stages of a proposed development. Planned unit development and clustered development are the best avenues for adaptation of solar pond technology.

Developed areas must be retrofitted to utilize the service provided by solar ponds. The initial problems associated with retrofitting include politics, availability of sufficient adjacent land, and social and economic acceptance by those being served.

Throughout this study many individuals who were contacted expressed a great deal of interest in the project and the potential applications to each city. Information sources in Bozeman, Montana, indicate that retrofitting in areal subdivisions might be a distinct possibility since a set-aside parcel of open space is required in each development, primarily for park development. Most of these areas remain vacant and could be used for other purposes. Officials in Pendleton, Oregon, visualize the municipal airport as a good location for solar pond applications. Actual observations in Oklahoma City, Oklahoma, indicate the potential for locating vacant or unused land near existing developments is very good.

7.0 RECOMMENDATIONS

1. This study examines cities with a population of more than 10,000, which account for about 55 percent of the total U.S. population. The study does not address smaller urban areas or rural towns with populations between 2,500 and 10,000, which account for about 25 percent of the U.S. population. In response to the results of this study, it can be concluded that these smaller cities and towns with significant portions of undeveloped land would offer substantial land potential and lower land costs for solar pond applications. The accumulation of reliable data for smaller towns is generally more difficult, but it is believed that a study to assess the solar pond potential for this sector can be conducted and can be quite useful in estimating the overall potential of solar ponds. A negative aspect of solar pond applications in these smaller towns and cities is the lack of development diversity (limited commercial centers, no institutions).

The overall results of this study are based on three prototype cities in each region, and the selected cities are categorized on the basis of their population density. In this study there has been no effort to determine whether the categorization of the cities based on population density is adequate. To illustrate this point, Oklahoma City, Oklahoma, with a population of 365,916, is categorized as a low-density city along with Bainbridge, Georgia, which has a population of only 10,722. In contrast, Liberal, Kansas, with a population of merely 14,533, is categorized as a high-density city along with Seattle, Washington, which has a population of 487,091. An alternative approach to the density methodology is to categorize the various prototype cities based on their actual population rather than population density. The existing prototype cities can be reclassified into three population ranges:

greater than or equal to 10,000 but less than 20,000;

greater than or equal to 20,000 but less than 90,000; and

greater than or equal to 90,000.

This reclassification would place nine cities in each of the categories, excluding Anchorage, Honolulu, and San Juan.

Considering the data base presented in this report, it is possible to estimate the total pond-suitable land (PSL) for different-sized cities based on population. The extension of the present study in this regard is recommended for the following reasons:

It will provide an alternative approach for estimating the total PSL, thereby providing a comparison of the results for the present study;

Since the results of the proposed study will be in the form of total PSL versus city size, it would be possible to estimate the solar pond land potential for smaller-sized cities by extrapolation of the data from cities with populations between 10,000 and 20,000 to cities with populations between 5,000 and 10,000; and

Because the study would be performed by using the existing data base in this report, such a study can be completed efficiently and cost effectively. Depending upon the scope of work, it is estimated that such a study can be developed and performed in 2 to 3 months.

2. Other factors that may be quite important but have not been considered in this assessment are the influence of the land surrounding a city and the local population growth trends. As described in Chapter 6, these factors can govern the changes in a city's planning policies, and a city may begin to expand. Even though the Northeast region may show the largest amount of PSL (based on the total vacant land presently available), it is believed that the greatest solar pond potential may lie in the Red River and Tennessee Valley regions because of the abundant availability of vacant land surrounding the cities in these regions.

Because of time and resource constraints, the study presented in this report is quite comprehensive, yet general in scope. The results summarize the total unused land potentially available for solar ponds. However, whether this land is actually suitable for solar ponds has not been specifically addressed. Factors such as land topography, soil type, land slope, etc.,

have not been included in the assessment of the overall land potential. Since all the above-mentioned factors are very important, it is recommended that they be addressed in detailed follow-up studies for specific districts based upon the results of the overall applicability studies by the Jet Propulsion Laboratory.

3. Regional or district solar pond land-availability and land-cost investigations for a number of strategic locations would be advantageous in the assessment of solar pond potential in locations supporting large supplies of inexpensive salt or salt brines. Examples include the Great Salt Lake in Utah and Owens Dry Lake in California.

4. Completion of the Jet Propulsion Laboratory applicability studies will determine overall solar pond feasibility and evaluate regional priorities. Upon completion, funding sources and target areas can be identified, and city-specific research can begin. The general approach would involve researching local politics and economics, public attitudes, physical limitations, existing development trends, and environmental constraints. Following this initial line of research, various areas of a city can be delineated as prime locations through the use of local land-use plans, topographic maps, and aerial photographs. Upon delineation of potential sites, ground truthing can take place to characterize each site and to define the possibilities and applications that exist. After target cities have been evaluated and feasibility determined, the planning, design, and construction of facilities can take place.

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R. Davis Winesett, Jr., is a community and regional planner with a master's degree in urban and regional planning. He has over 15 years experience in urban and regional planning and has been involved in many projects that required data collection, data organization and management, and the use of statistical techniques. Other areas of expertise include development market research, planning processes for new communities, large development complexes, and regional projects. Mr. Winesett is a corporate vice president, Planning, with The Benham Group. He served as principal-in-charge for this project with responsibilities for overall direction of the effort and is the final review authority for completeness and accuracy.

Kenneth C. Senour, Jr., is an environmental planner and geographer with a B.S. in biology and geography. He has over 9 years experience in supervising and implementing multidisciplinary projects, including water resources studies, preferred area environmental assessments, environmental impact studies, and special projects. He serves as a project manager for environmental services, The Benham Group. Mr. Senour served as project manager for this report with overall responsibility for coordination of client contacts, data collection, data analyses, report preparation, and report production.

Sharon J. Bell is a land-use and environmental planner with a master's degree in city and regional planning. She has 6 years experience in data collection, project organization and management, and report preparation including land management studies, neighborhood conservation projects, comprehensive plans, environmental impact studies, and zoning and subdivision reviews. She is a senior associate, Planning, with The Benham Group. Ms. Bell's responsibilities included data collection and analyses and report preparation.

Dr. Sally Caldwell is a sociologist with a Ph.D. in sociology. She has over 13 years experience in sociology, regional planning, and statistical analysis. She has been involved in a number of projects involving community and regional planning, social values, urban analysis, and statistical

methodologies. Dr. Caldwell is a university associate and is a member of the Regional and City Planning Department of the University of Oklahoma. Dr. Caldwell's responsibilities included data collection, development of statistical methodologies, application of the methodologies, data analyses, and report preparation.

Dr. Gurmukh D. Mehta is a mechanical engineer with a Ph.D. in mechanical engineering. He has made major contributions to a number of areas in renewable energy technology and has been involved in the development of nonconvective solar ponds for the last 6 years. He has presented several technical papers on various aspects of solar pond systems in technical meetings and conferences. He is a highly qualified program manager and has successfully managed six Department of Energy funded contracts related to salt-stratified solar ponds. Dr. Mehta is employed by Science Applications, Inc., and served as the consultant energy specialist on this project and provided valuable input regarding the operation and application of solar ponds.

APPENDICES SECTION

APPENDIX A

EXHIBIT A

Summary of Regional Analyses
for Selection of Cities
(Population Density)

Region	Total Number of Cities Analyzed	Total in Each Density Category: High	Medium	Low	Mean Density[a]	Standard Deviation	Ranges for Each Density Category[a]: Low	Medium	High
Alaska	3	1	2	0	4,709	4,573	≤136	137-9,281	≥9,282
Atlantic Northeast	518	89	331	98	3,333	2,617	≤716	717-5,949	≥5,950
Black Hills	42	7	28	7	3,011	1,025	≤1,986	1,987-4,035	≥4,036
Great Lakes	591	86	434	71	3,387	1,780	≤1,607	1,608-5,166	≥5,167
Gulf Coast	247	34	192	21	2,504	1,534	≤970	971-4,037	≥4,038
Hawaii	9	2	5	2	5,197	2,360	≤2,837	2,838-7,556	≥7,557
Pacific Northwest	71	7	56	8	2,645	1,184	≤1,461	1,462-3,828	≥3,829
Puerto Rico	1	--	--	--	--	--	--	--	--
Red River	197	22	156	19	2,100	1,186	≤914	915-3,285	≥3,286
Salt Lake	62	8	47	7	2,852	1,358	≤1,494	1,495-4,209	≥4,210
South West	228	45	147	36	3,883	2,233	≤1,650	1,651-6,115	≥6,116
Tennessee Valley	245	31	197	17	2,639	1,604	≤1,035	1,036-4,242	≥4,243
Totals	2,214	332	1,595	286					

[a]Reported in people per square mile.

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EXHIBIT B

No.: __________
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REGION: __________

CITY: __________

DENSITY: L M H

JPL: SOLAR POND STUDY
Urban Characteristics
Survey Form

1.0 CITY CONTACTS

1.1 NAME: __________

1.2 TITLE: __________

1.3 ADDRESS: __________

____

____

1.4 PHONE NO.: __________

2.0 GENERAL CHARACTERISTICS

2.1 1980 POPULATION: __________

2.2 1980 LAND AREA: __________

2.3 1980 DENSITY: __________

2.4 1975 DENSITY: __________

3.0 PHYSICAL CHARACTERISTICS

3.1 FLAT: Y N

3.2 ROLLING: Y N

3.3 HILLY/MOUNTAINOUS: Y N

3.4 VEGETATION: FORESTED _____ %

GRASSLAND/OPEN _____ %

4.0 URBAN CHARACTERISTICS (Request a copy of any of the ordinances, plans, etc. they have)

4.1 LAND USE CONTROLS

4.1.1 PLANNING AND ZONING CODES AVAILABLE: Y N

4.1.2 INTENSITY OF DEVELOPMENT SPECIFIED: Y N

4.1.3 LAND USE/COMPREHENSIVE PLAN AVAILABLE: Y N

4.1.4 IS ZONING ENFORCED: Y N

4.1.5 OTHER AVAILABLE INFORMATION: ______________________

____

____

4.2 LAND AVAILABILITY

4.2.1 RESIDENTIAL: TOTAL ACRES ______________

DEVELOPED ______________

UNDEVELOPED ______________

% OPEN SPACE ______________

4.2.2 IS THE ABOVE INFORMATION AVAILABLE FOR EACH ZONING CATEGORY: Y N

4.2.3 COMMERCIAL: TOTAL ACRES ______________

DEVELOPED ______________

UNDEVELOPED ______________

% OPEN SPACE ______________

4.2.4 IS THE ABOVE INFORMATION AVAILABLE FOR EACH ZONING CATEGORY: Y N

4.2.5 INSTITUTIONAL: TOTAL ACRES ______________

DEVELOPED ______________

UNDEVELOPED ______________

% OPEN SPACE ______________

4.2.6 MAJOR INSTITUTIONS/UNIVERSITIES: ______________________

____

4.3 LAND VALUES

4.3.1 CONTACTS

4.3.1.1 Name: ______________________________

4.3.1.2 Title: ______________________________

4.3.1.3 Address: ______________________________

____

____

4.3.1.4 Phone No.: ______________________________

4.3.2 FOR LAND VALUES, CAN THE CITY BE DIVIDED INTO SECTIONS: Y N

4.3.3 IF SO, WHAT SECTIONS: E - W

N - S

NE-NW-SE-SW

4.3.4 SPECIFIC DATA

CATEGORY	SECTION	LOW ($/acre)	MEDIUM ($/acre)	HIGH ($/acre)
Residential	E			
	W			
	N			
	S			
	NE			
	NW			
	SE			
	SW			
Commercial	E			
	W			
	N			
	S			
	NE			
	NW			
	SE			
	SW			
Institutional	E			
	W			
	N			
	S			
	NE			
	NW			
	SE			
	SW			

5.0 TRENDS

5.1 DEMOGRAPHIC

5.1.1 GROWTH: ______________________________

5.1.2 SHIFTING: ______________________________

5.2 DEVELOPMENT

5.2.1 5-YR. FORECAST: ______________________________

____

____

6.0 FORM COMPLETED BY: ______________________________

TITLE: ______________________________

DATE: ______________________________

The BenhamGroup

EXHIBIT C

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Corporate Offices

June 10, 1981

Office of the Select Man
City of Derry
48 East Broadway
Derry, New Hampshire 03038
Area Code 603/432-7553

Gentlemen:

The Benham Group is collecting land availability and land values data for 30 cities in the United States. The information is for a solar pond feasibility study. A solar pond is an innovative solar energy technology requiring solar radiation, land, water, and salts. Derry was selected as representative low density city for the Atlantic Northeast region.

To assist our research, we are requesting a copy of the following information:

1. The section of the zoning code which discribes the different zoning districts and minimum lot size requirements.

2. The Land Use/Comprehensive Plan as adopted.

3. Total number of acres of residential land (for each zoning category, if possible) and the ratio between developed and undeveloped land.

4. Total number of acres of commercial land (for each zoning category, if possible) and the ratio between developed and undeveloped land.

5. Total number of acres of institutional land (for each zoning category, if possible) and the ratio between developed and undeveloped land.

6. A list of major institutions/universities in Derry.

7. The range (low, medium and high) in land values ($/acre) for residential, commercial and institutional lands. Does this range vary according to location in different sectors of the city (i.e., a north vs south or east vs west location)? Alternatively, is there a real estate appraiser we can contact who is familar with land values in the town?

1200 Northwest 63rd • P.O. Box 20400 • Oklahoma City, Oklahoma 73156 405 / 848-6631 Telex BBAF OKC 748 96.

8. The population for Derry.

9. The 1980 land area (acres or square miles) for the town. Are there any plans for annexation or deannexation in the near future?

10. Overall, what do you foresee as the demographic and/or development and growth trends and changes for Derry over the next five years?

If there is a charge for any of the above information, invoice The Benham Group.

Please send the information to:

Mr. Ken Senour
The Benham Group
P.O. Box 20400
Oklahoma City, Oklahoma 73156
Phone: (405) 848-6631

Enclosed is a brochure describing The Benham Group. Thank you for your time and assistance.

Very truly yours,

THE BENHAM GROUP

Sharon J. Bell, AICP
Senior Associate

SJB/aj
Enclosure
cc: Ken Senour

EXHIBIT D

EXPLANATION OF INFORMATION PRESENTED IN RETROFIT AND THEORETICAL MAXIMUM VALUE TABLES, FOOTNOTE e, CHAPTER 3

For the purposes of table organization, the requirements for larger lot sizes are always listed under column 10 (the low-density column) on the land-availability tables in Chapter 3. However, there is an inverse relationship between intensity of use/density and minimum lot requirements for residential uses vis-a-vis commercial uses.

The lowest intensity residential use such as large-lot single family uses also has the largest land-area requirements, whereas more intense land uses such as high-rise apartment buildings have an overall decrease in land-area requirements for each dwelling unit. In Oklahoma City the "R-A" rural dwelling district requires a 2-acre minimum lot per dwelling unit while a high-rise apartment building requires 1,000 square feet per dwelling unit. Figure A-1 illustrates this relationship.

The relationship between intensity of land use and land-area needs is the opposite for commercial-type uses. For example, agricultural or heavy machinery sales and service requires considerable space while a shoe repair or dry cleaning shop has minimal space needs. Again, using Oklahoma City as an example, the "C-4" general business district, an intensive land use, has a minimum lot size of 40,000 square feet, but the "C-1" neighborhood commercial district only requires 5,000 square feet. Figure A-1 illustrates this phenomenon.

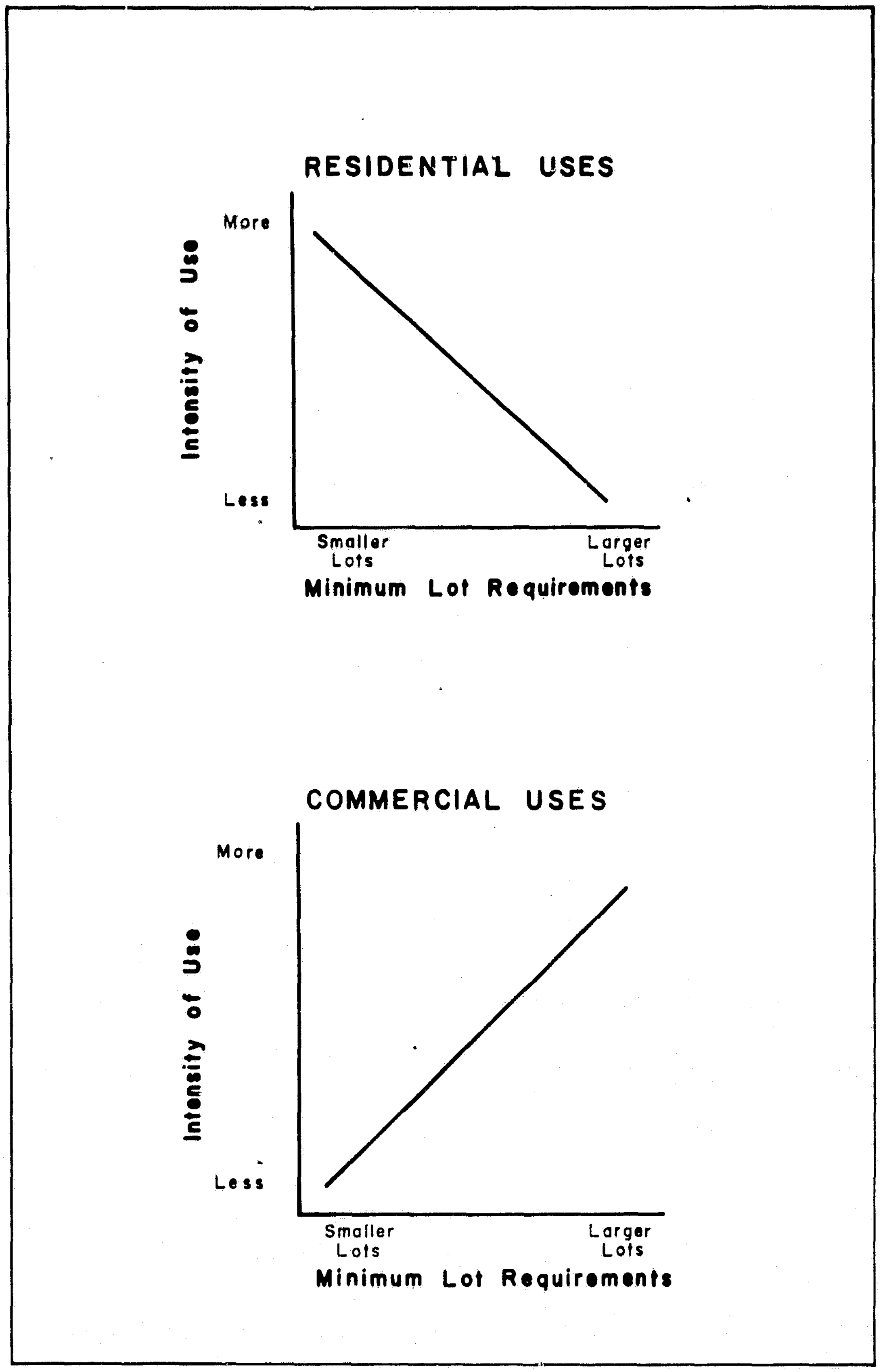


FIGURE A-1

Relationship Between
Lot Size and Land Use
Intensity

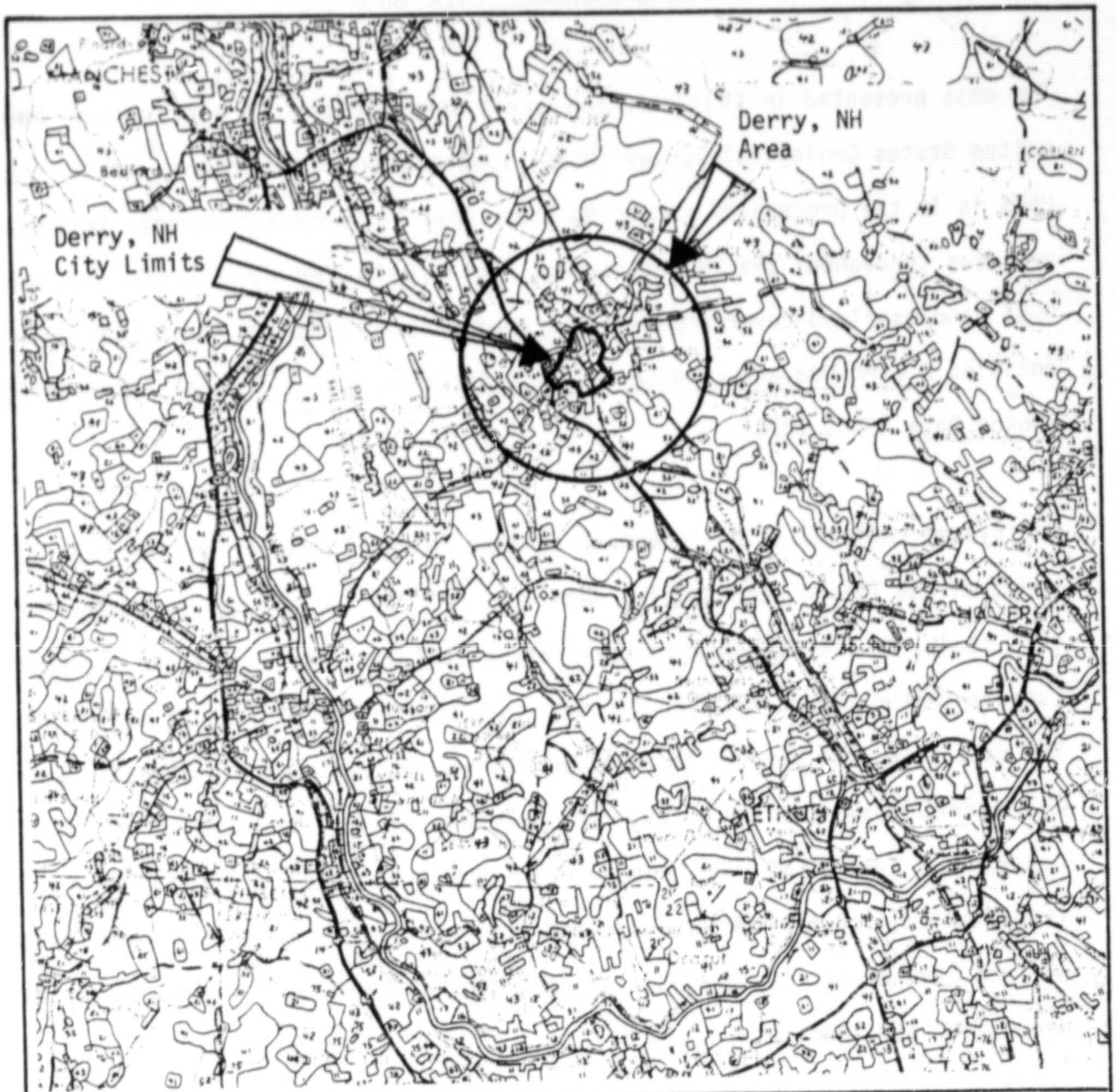
APPENDIX B

LAND-USE/LAND-COVER MAPS

The maps presented in this section are reproductions of portions of the United States Geological Survey (USGS) land-use and land-cover maps. The USGS is in the process of preparing these maps to represent general land-use patterns throughout the United States. For a detailed description of the USGS land-use/land-cover program, the reader is referred to the publication entitled <u>A Land Use and Land Cover Classification System for Use with Remote Sensor Data</u> (USGS 1976).

The system employed is basic and is defined to two levels of resolution, as shown on the legend accompanying each map. Of the 30 cities selected for this study, 18 are included in the present USGS land-use/land-cover system. Each presented map highlights the area surrounding the city being evaluated. The data shown are general but are indicative of development patterns within and surrounding a given city. Of special importance to this study is category 1 (urban or built-up land), specifically subcategories 11 (residential) and 12 (commercial), and its relationship to surrounding land use and land cover. An analysis of each map is presented in the narrative discussion for that city.

These maps are at a scale of 1:250,000 (with the exception of Seattle, WA) and have been developed from the base USGS 1:250,000 topographic quadrangle series. For a more detailed description of the geographic characteristics of each area shown, the reader is encouraged to secure and review the appropriate 1:250,000 or 1:24,000 topographic map available through USGS.



Source: USGS 1979b.

Scale: 1:250,000

FIGURE B-1
Land-Use/Land-Cover
Map for Derry, NH

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
74 Bare exposed rocks
75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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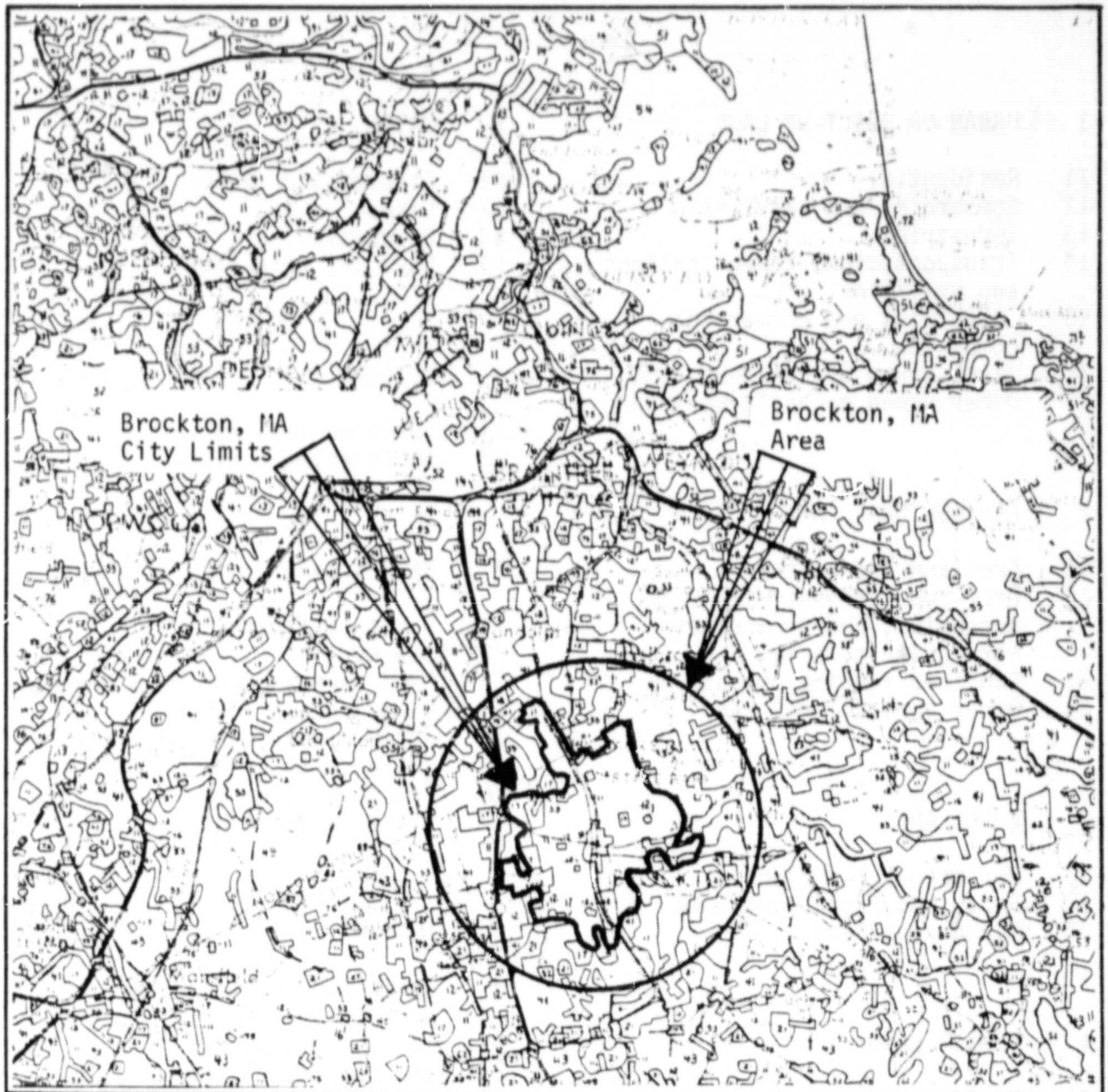

Source: USGS 1979b.

Scale: 1:250,000

FIGURE B-2
Land-Use/Land-Cover
Map for Brockton, MA

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
74 Bare exposed rocks
75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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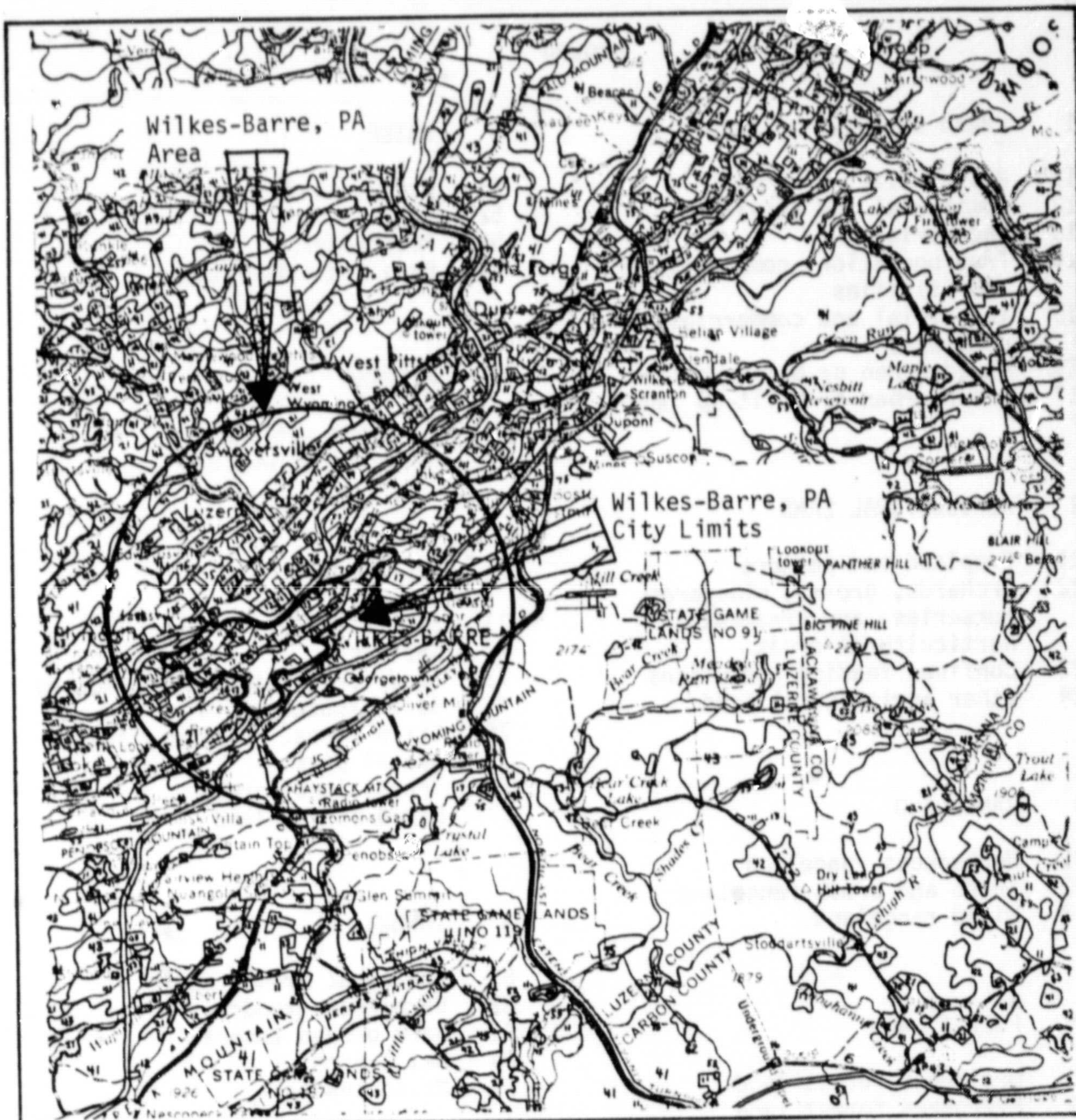

Source: USGS 1979j.

Scale: 1:250,000

FIGURE B-3
Land-Use/Land-Cover
Map for Wilkes-Barre, PA

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
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75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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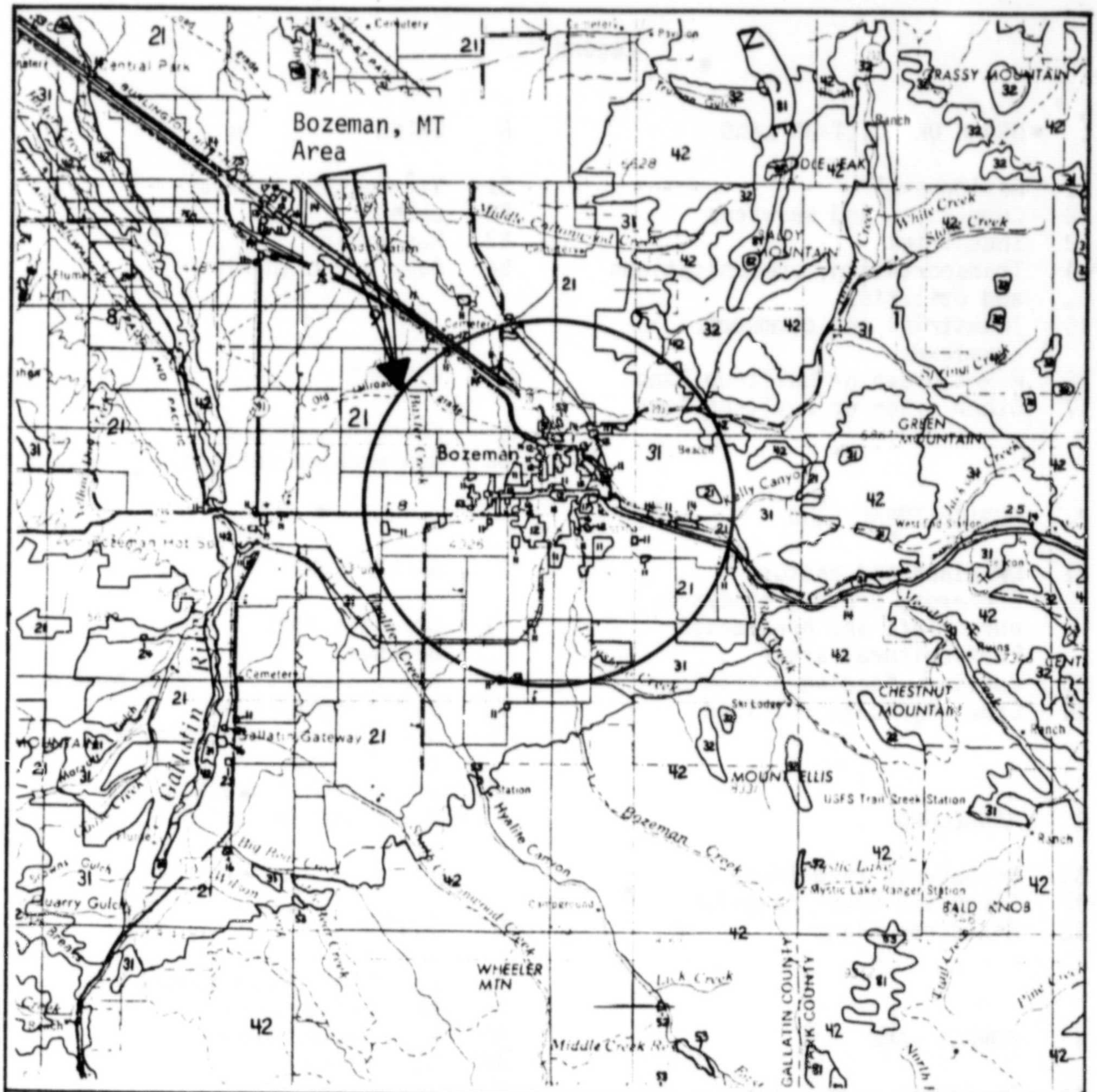

Source: USGS 1980a.

Scale: 1:250,000

FIGURE B-4
Land-Use/Land-Cover
Map for Bozeman, MT

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
74 Bare exposed rocks
75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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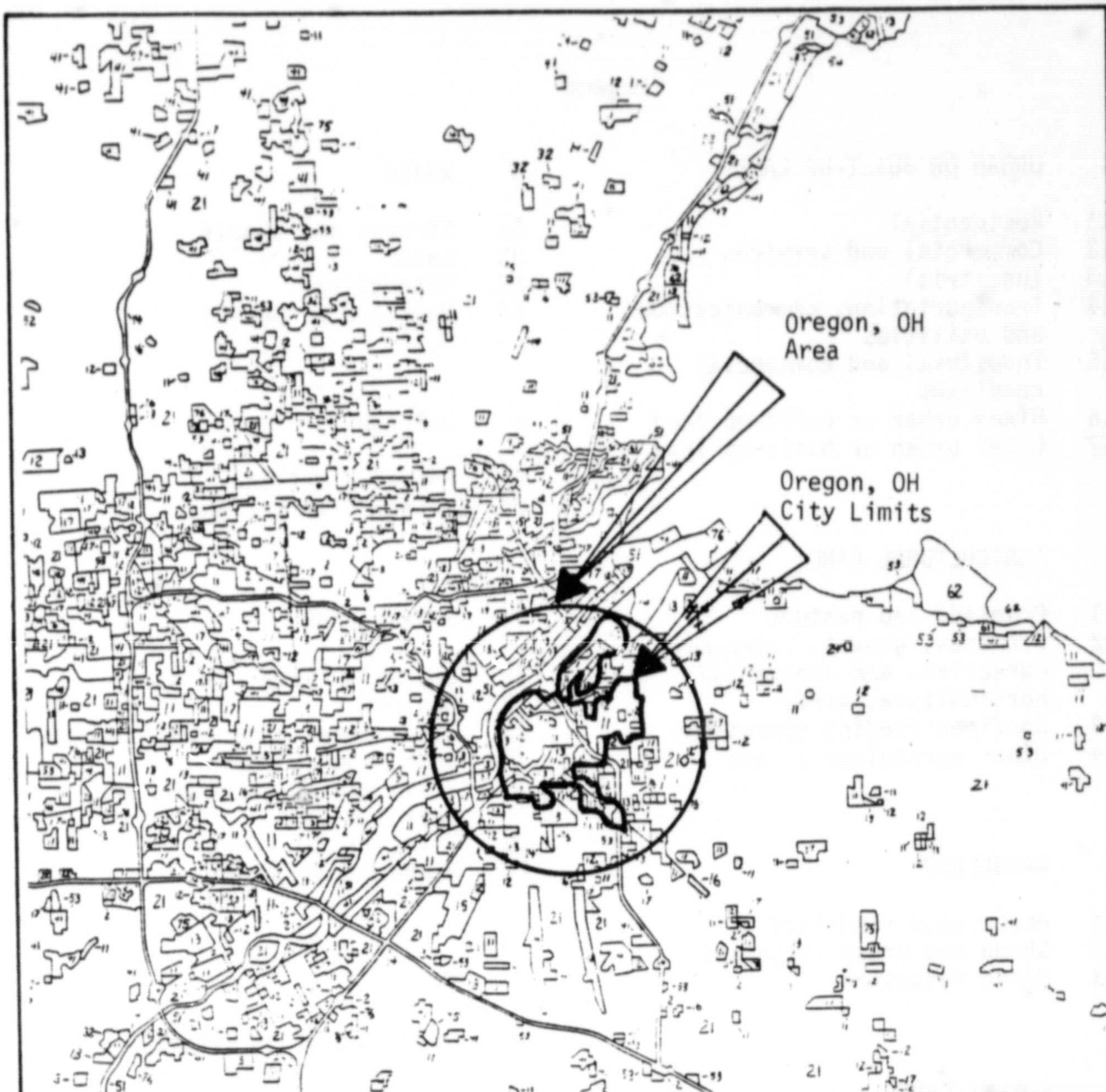

Source: USGS 1979m.

Scale: 1:250,000

FIGURE B-5
Land-Use/Land-Cover
Map for Oregon, OH

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
74 Bare exposed rocks
75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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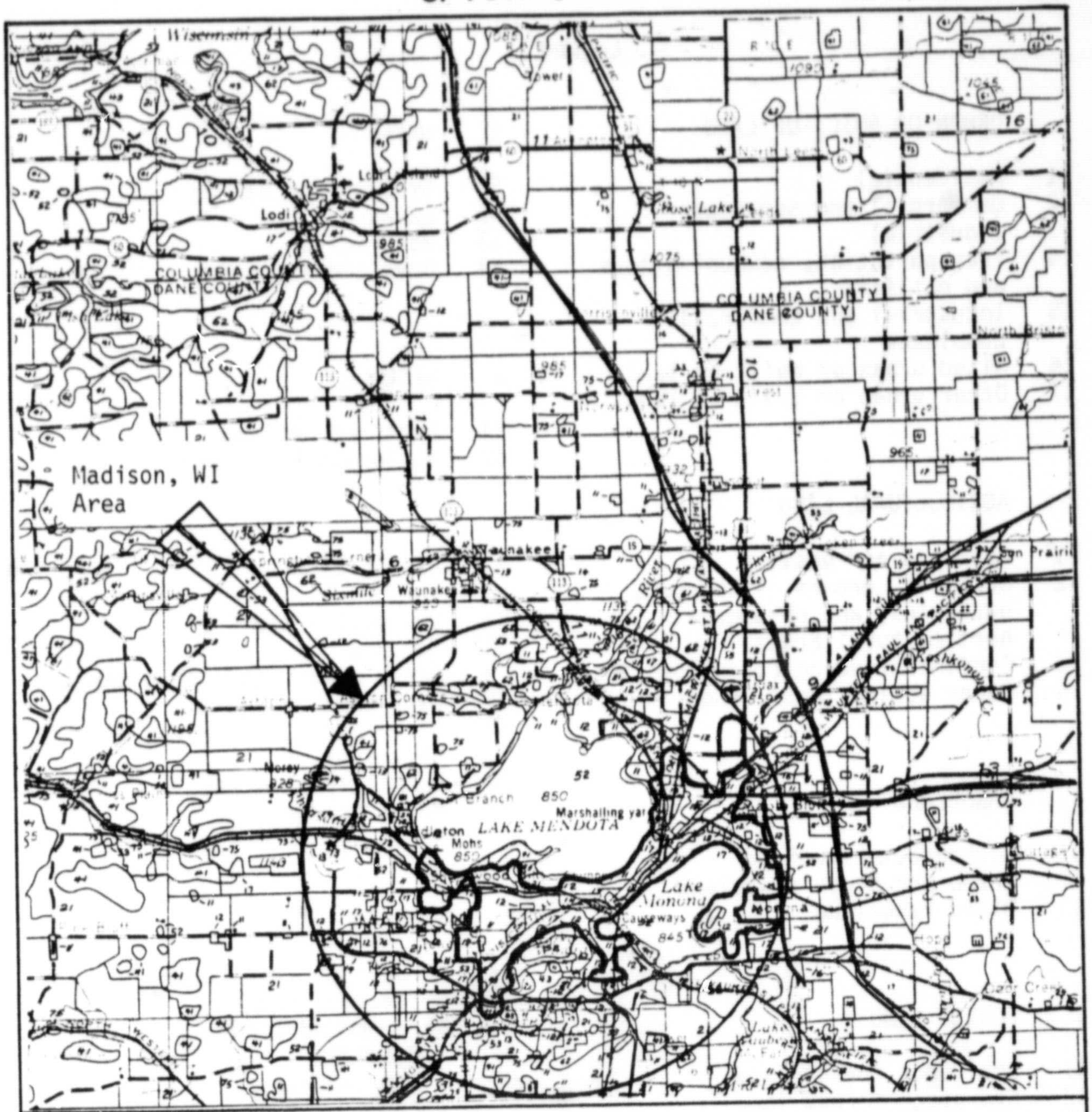

Source: USGS 1980c.

Scale: 1:250,000

FIGURE B-6
Land-Use/Land-Cover
Map for Madison, WI

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
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3 RANGELAND

31 Herbaceous rangeland
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4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
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5 WATER

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52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

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72 Beaches
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75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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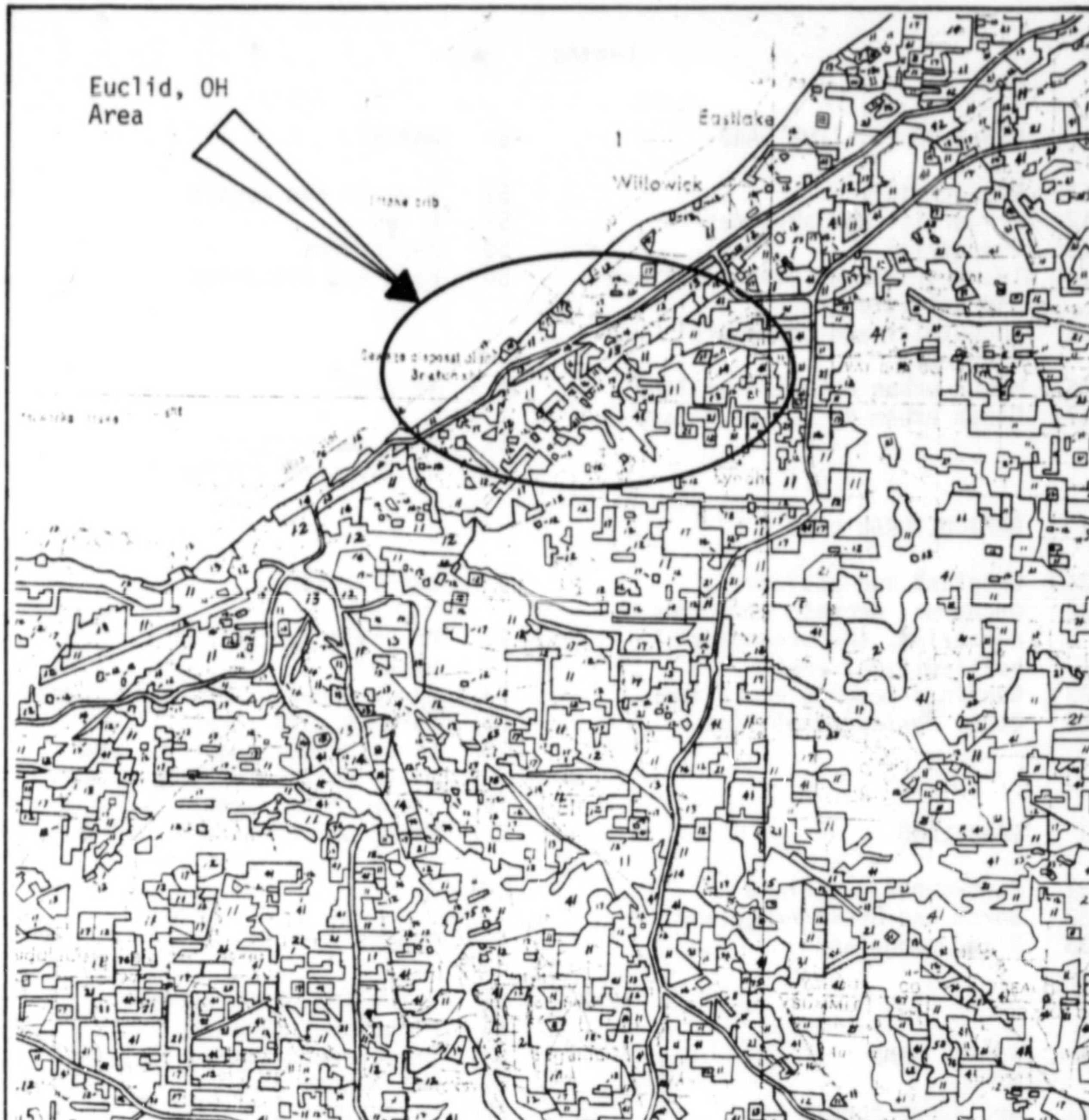

Source: USGS 1979c.

Scale: 1:250,000

FIGURE B-7
Land-Use/Land-Cover
Map for Euclid, OH

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
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33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

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52 Lakes
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54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

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72 Beaches
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75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

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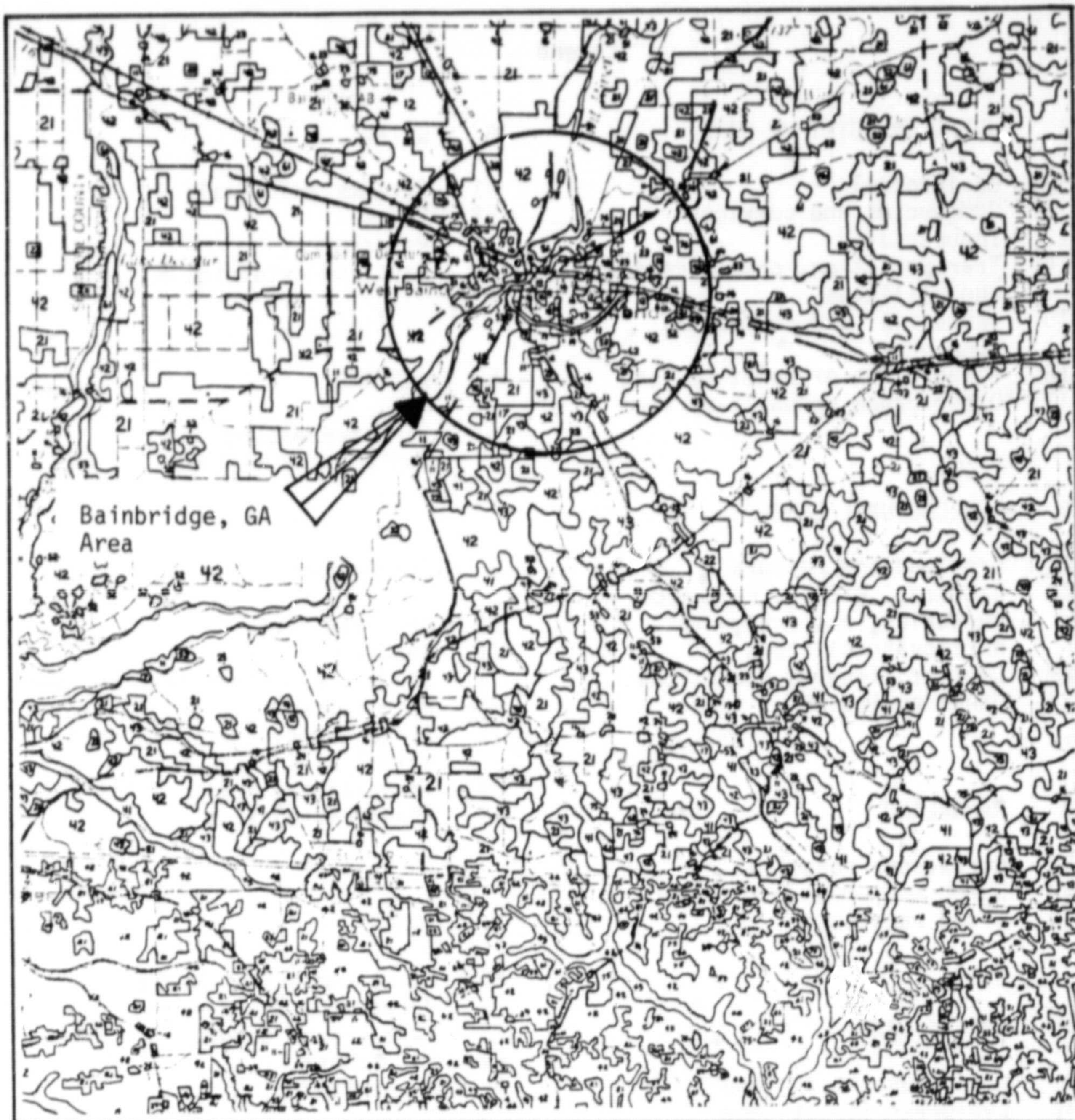
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers



Source: USGS 19791.

Scale: 1:250,000

FIGURE B-8
Land-Use/Land-Cover
Map for Bainbridge, GA

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

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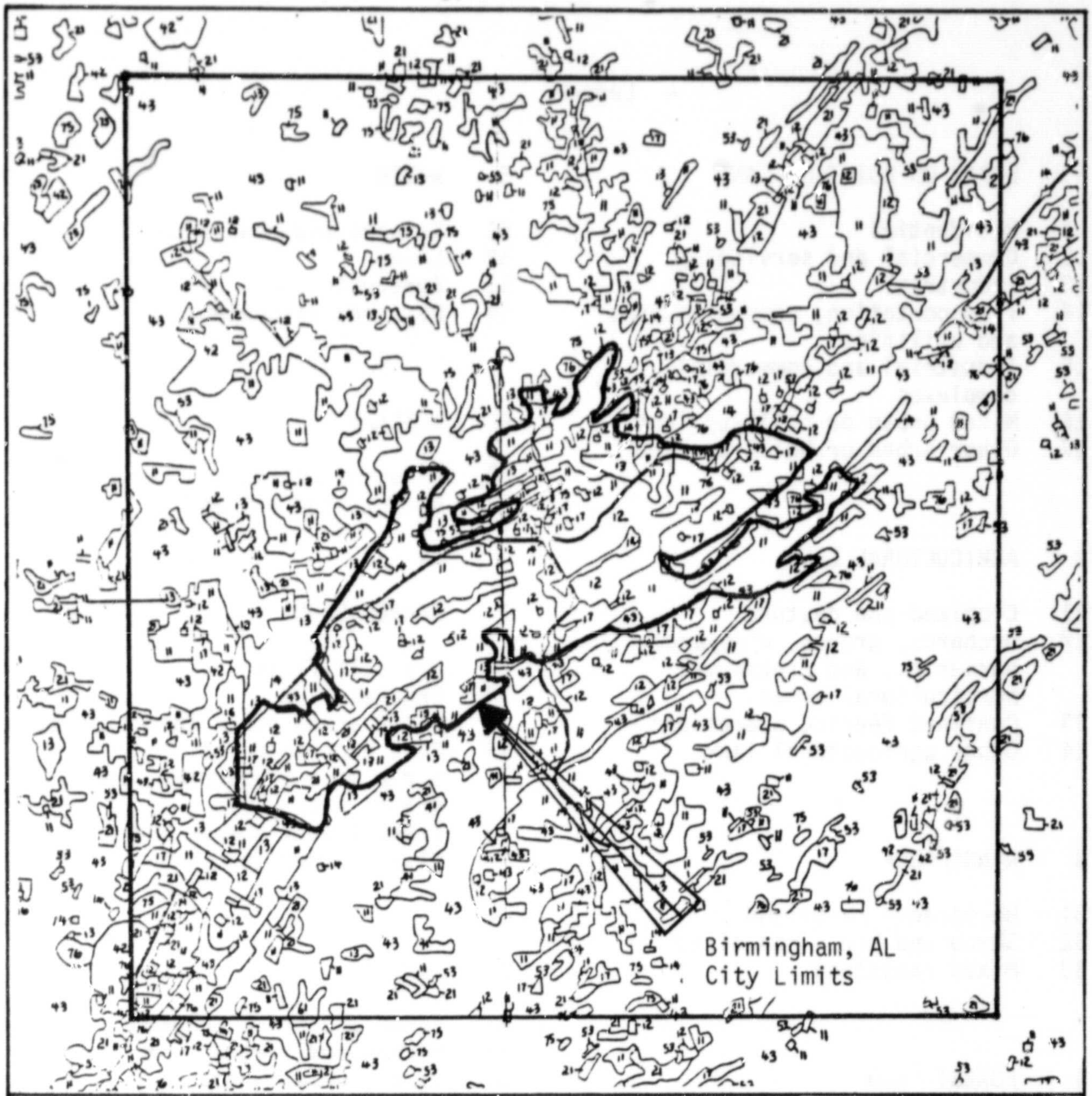
8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers



Source: USGS 1979a.

Scale: 1:250,000

FIGURE B-9
Land-Use/Land-Cover
Map for Birmingham, AL

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
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77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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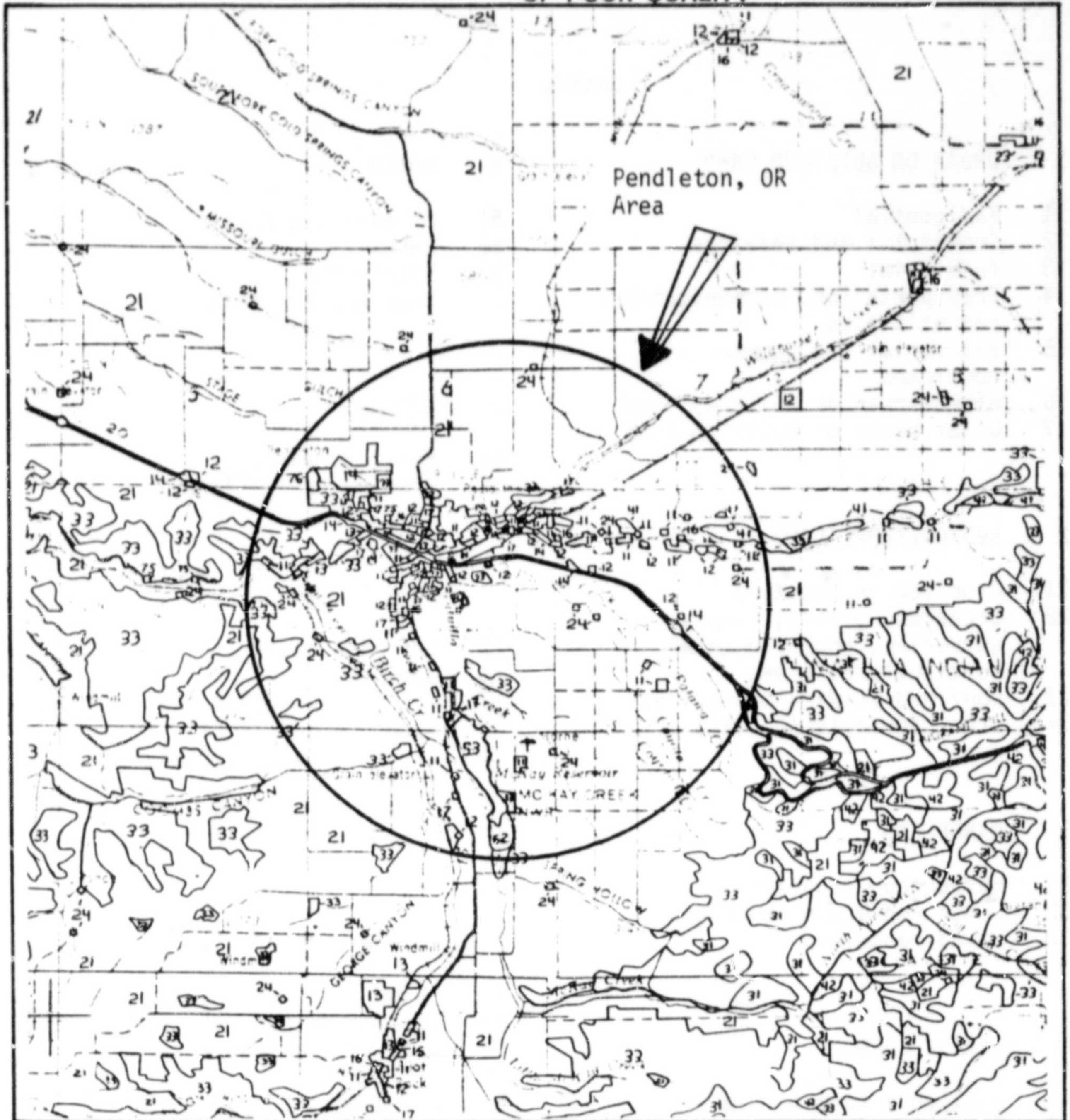

Source: USGS 1980d.

Scale: 1:250,000

FIGURE B-10
Land-Use/Land-Cover
Map for Pendleton, OR

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
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23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

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33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
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43 Mixed forest land

5 WATER

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52 Lakes
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54 Bays and estuaries

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75 Strip mines, quarries, and gravel pits
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77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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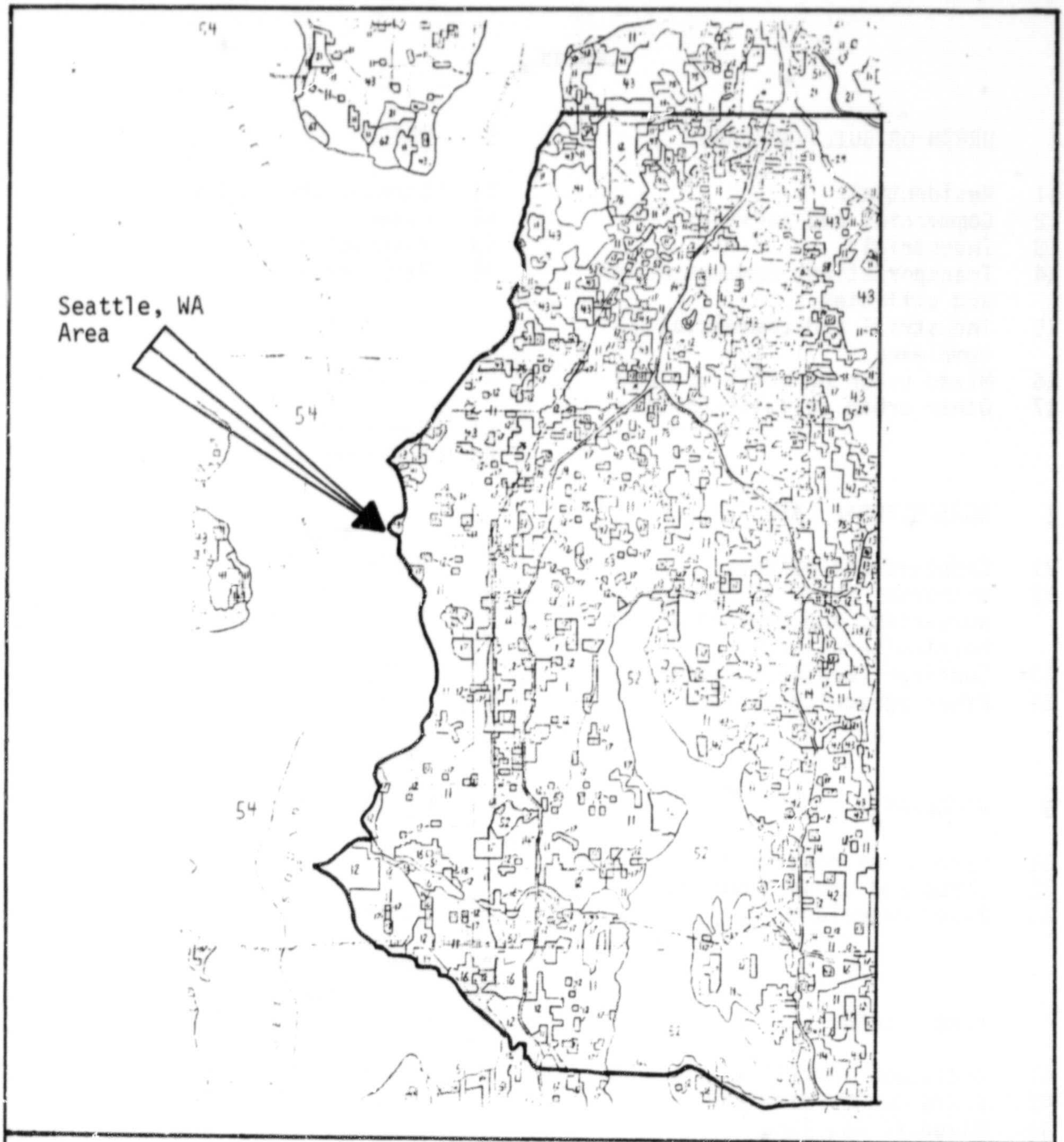

Source: USGS 1979k.

Scale: 1:100,000

FIGURE B-11
Land-Use/Land-Cover
Map for Seattle, WA

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
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33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
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54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
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75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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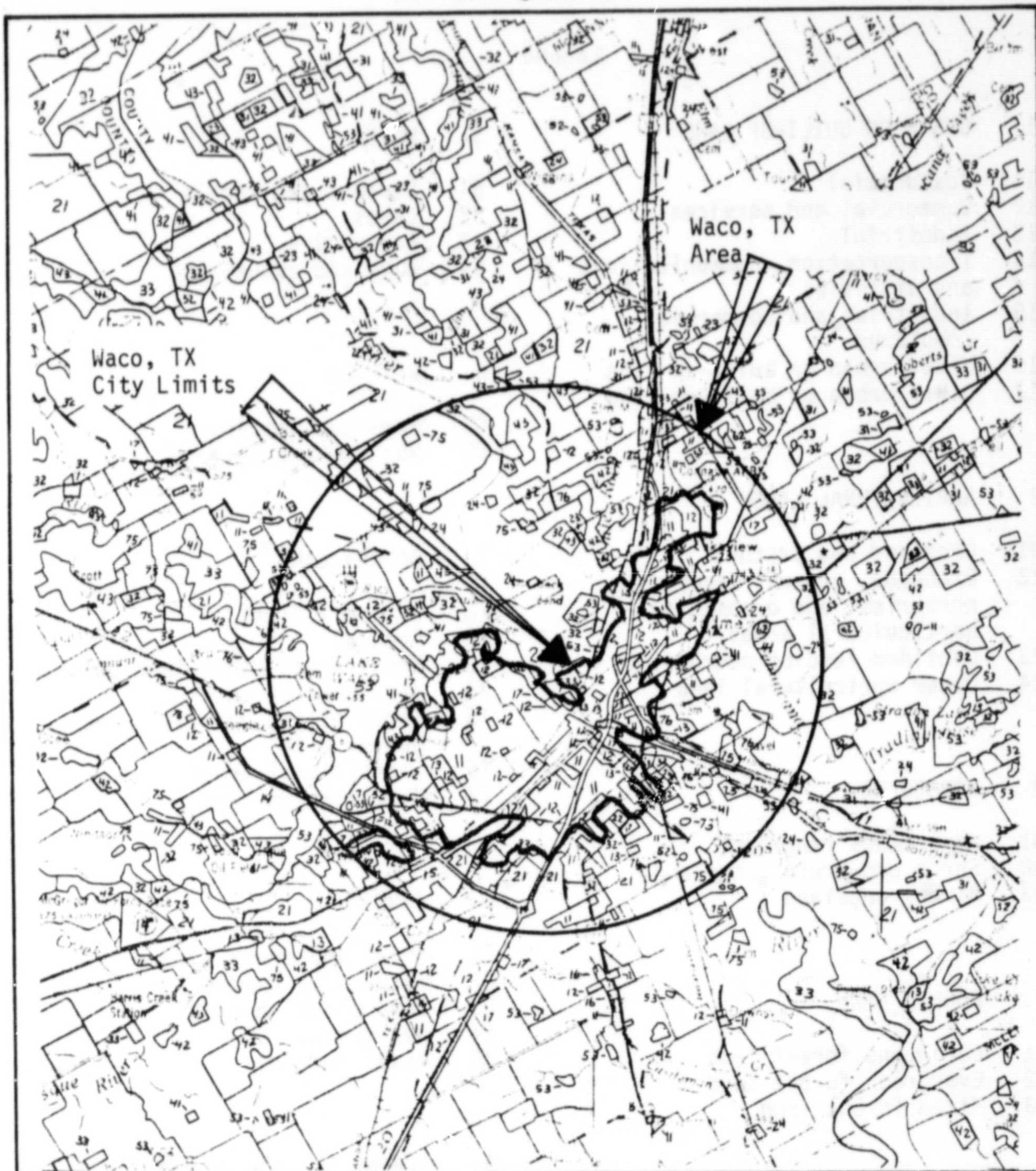

Source: USGS 1980e.

Scale: 1:250,000

FIGURE B-12
Land-Use/Land-Cover
Map for Waco, TX

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
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6 WETLAND

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7 BARREN LAND

71 Dry salt flats
72 Beaches
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75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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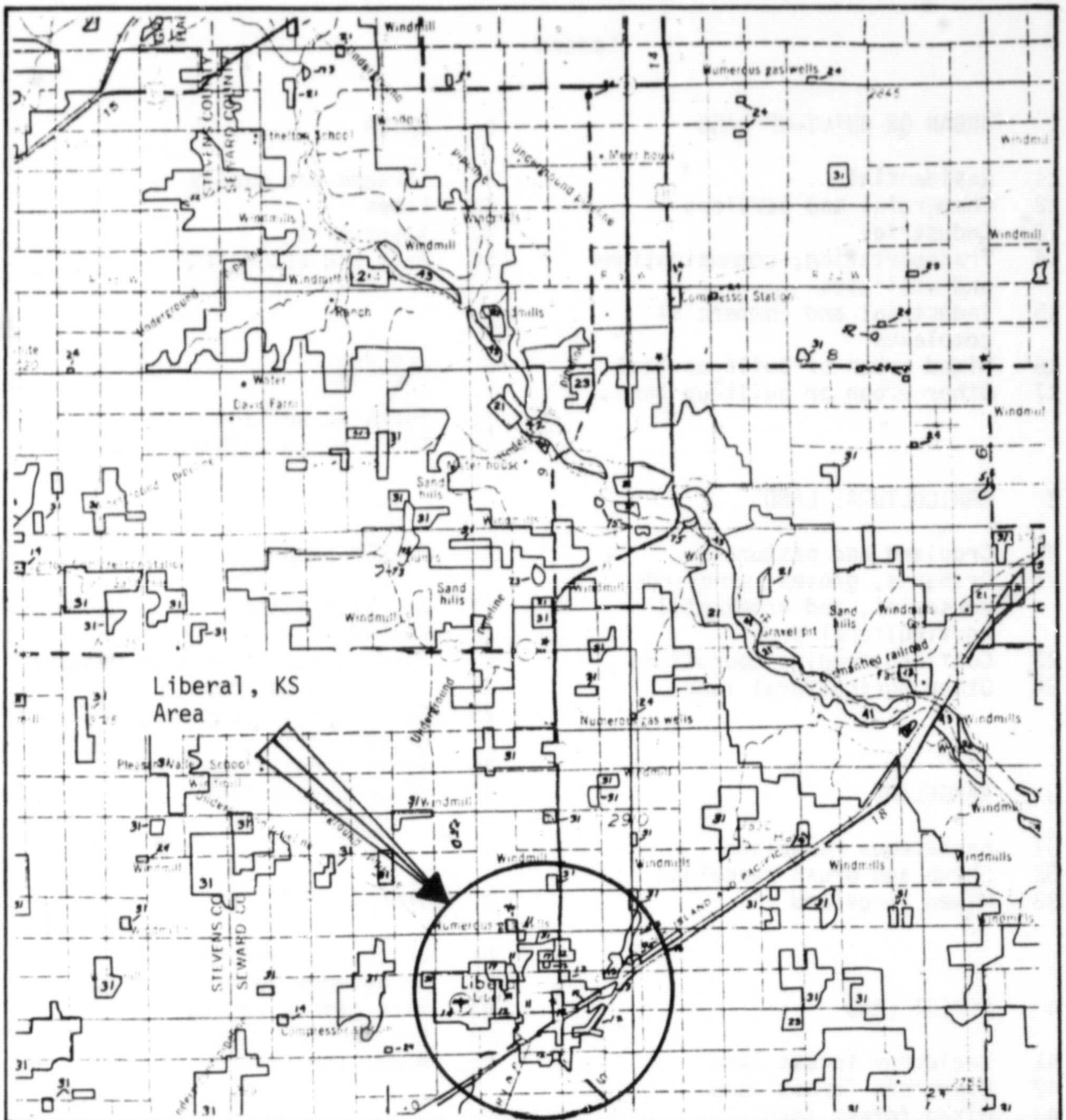

Source: USGS 1979d.

Scale: 1:250,000

FIGURE B-13
Land-Use/Land-Cover
Map for Liberal, KS

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
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54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
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75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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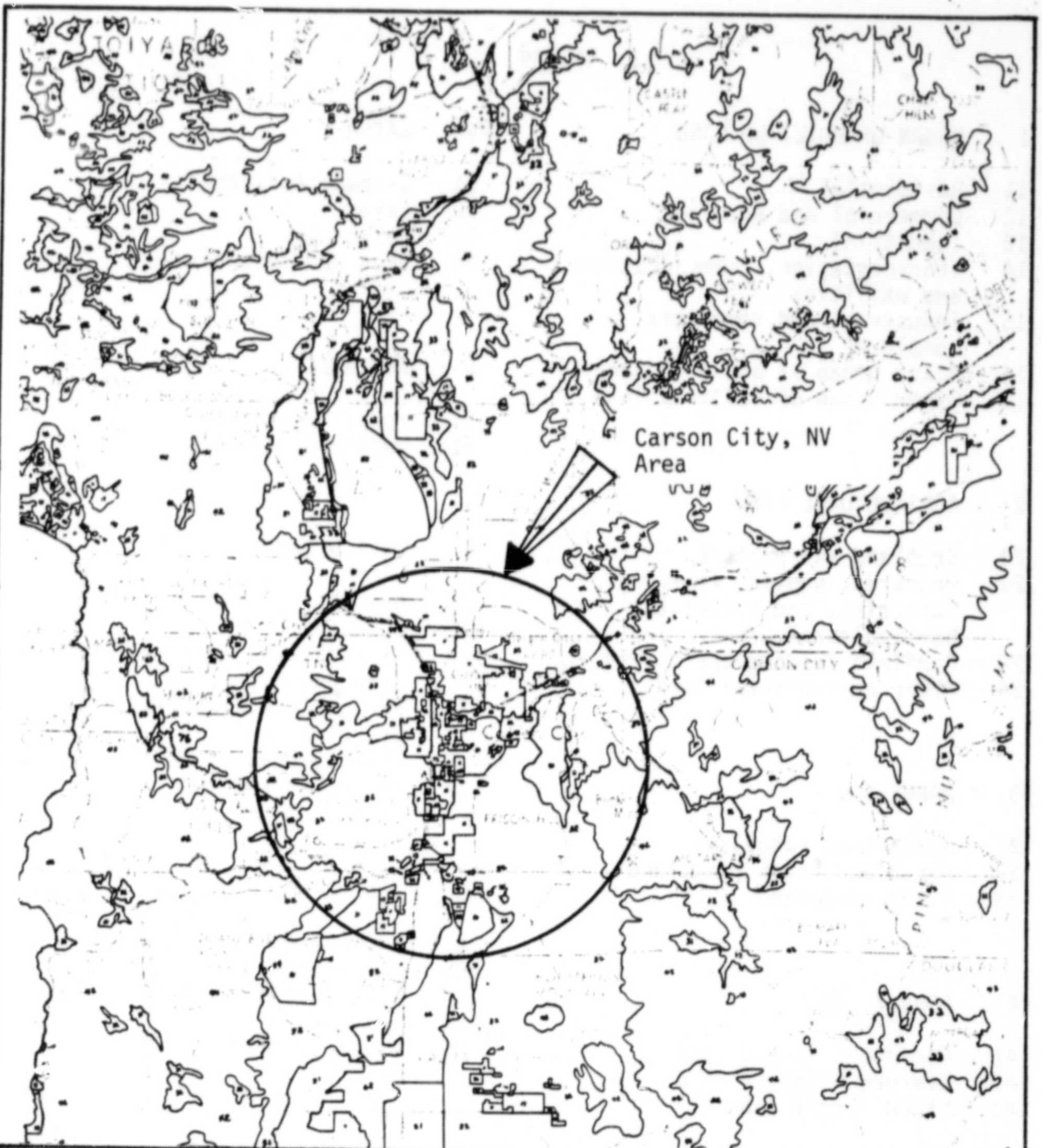

Source: USGS 1979h.

Scale: 1:250,000

FIGURE B-14
Land-Use/Land-Cover
Map for Carson City, NV

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

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32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
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6 WETLAND

61 Forested wetland
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72 Beaches
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77 Mixed barren land

8 TUNDRA

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83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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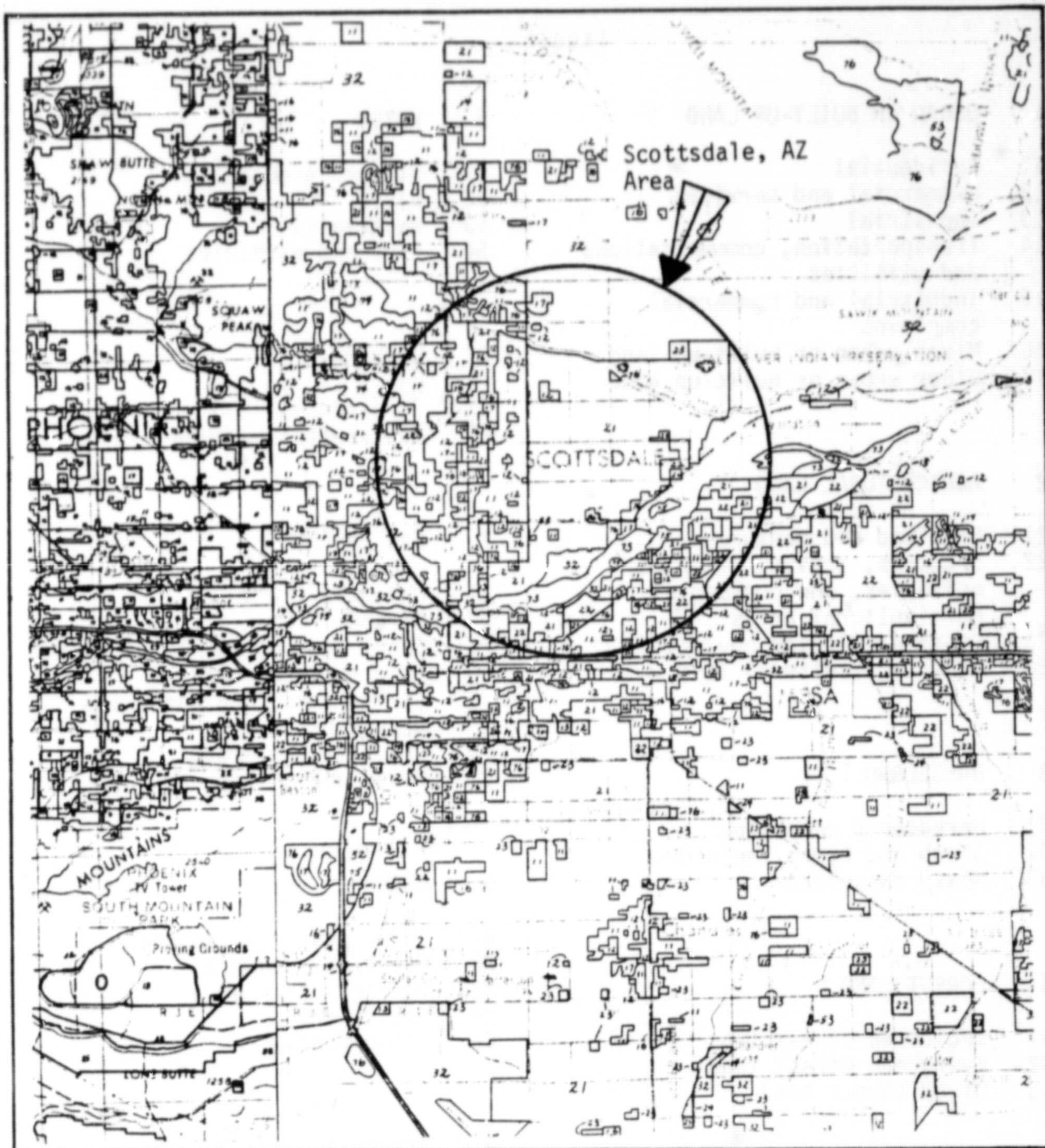


Source: USGS 1979f;
1979g.

Scale: 1:250,000

FIGURE B-15
Land-Use/Land-Cover
Map for Scottsdale, AZ

Legend

1 URBAN OR BUILT-UP LAND

- 11 Residential
- 12 Commercial and services
- 13 Industrial
- 14 Transportation, communications and utilities
- 15 Industrial and commercial complexes
- 16 Mixed urban or built-up land
- 17 Other urban or built-up land

2 AGRICULTURAL LAND

- 21 Cropland and pasture
- 22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
- 23 Confined feeding operations
- 24 Other agricultural land

3 RANGELAND

- 31 Herbaceous rangeland
- 32 Shrub and brush rangeland
- 33 Mixed rangeland

4 FOREST LAND

- 41 Deciduous forest land
- 42 Evergreen forest land
- 43 Mixed forest land

5 WATER

- 51 Streams and canals
- 52 Lakes
- 53 Reservoirs
- 54 Bays and estuaries

6 WETLAND

- 61 Forested wetland
- 62 Nonforested wetland

7 BARREN LAND

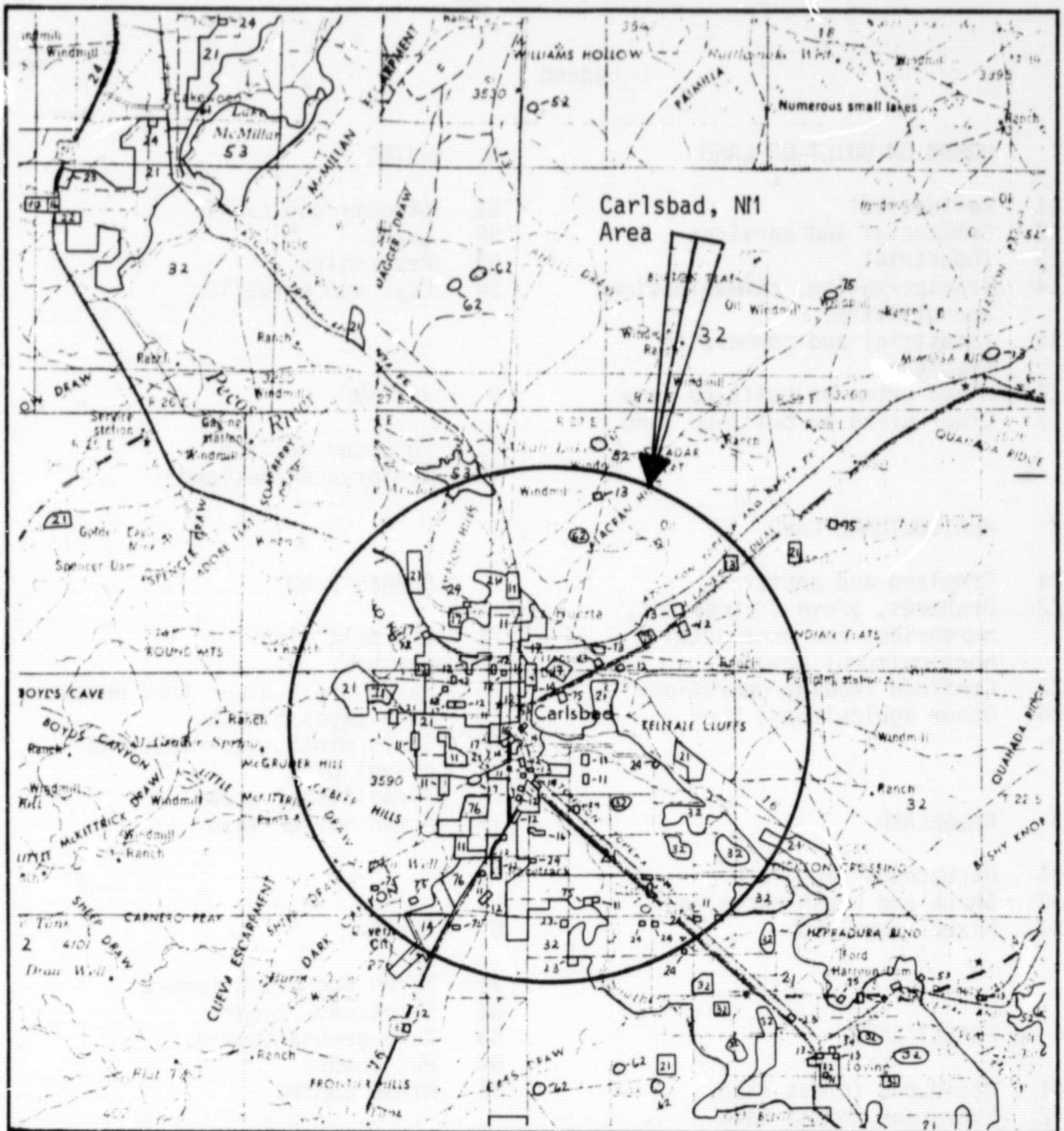
- 71 Dry salt flats
- 72 Beaches
- 73 Sandy areas other than beaches
- 74 Bare exposed rocks
- 75 Strip mines, quarries, and gravel pits
- 76 Transitional areas
- 77 Mixed barren land

8 TUNDRA

- 81 Shrub and brush tundra
- 82 Herbaceous tundra
- 83 Bare ground tundra
- 84 Wet tundra
- 85 Mixed tundra

9 PERENNIAL SNOW OR ICE

- 91 Perennial snowfields
- 92 Glaciers



Source: USGS 1980b.

Scale: 1:250,000

FIGURE B-16
Land-Use/Land-Cover
Map for Carlsbad, NM

C-4

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

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9 PERENNIAL SNOW OR ICE

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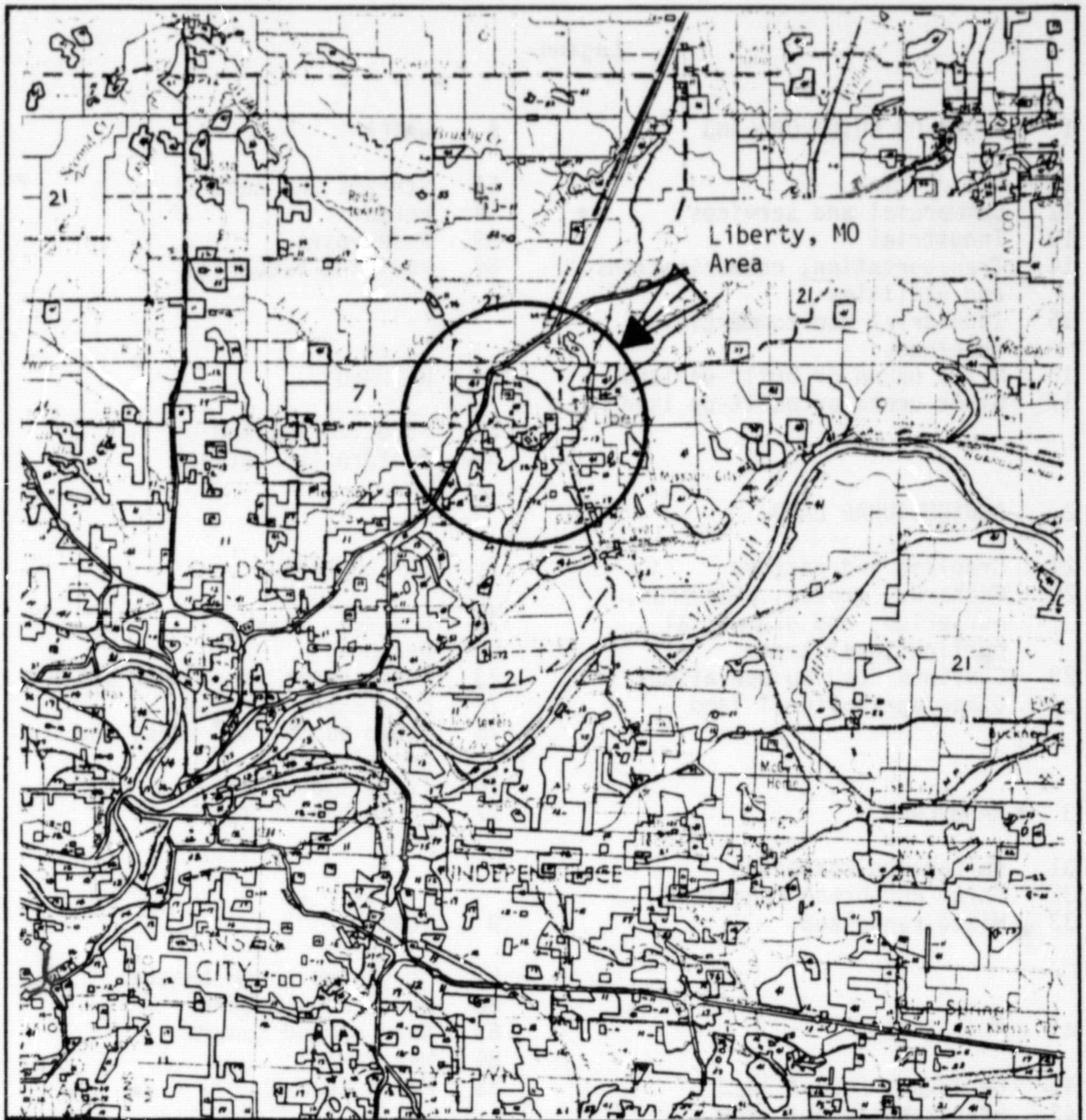

Source: USGS 1979e.

Scale: 1:250,000

FIGURE B-17
Land-Use/Land-Cover
Map for Liberty, MO

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
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83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

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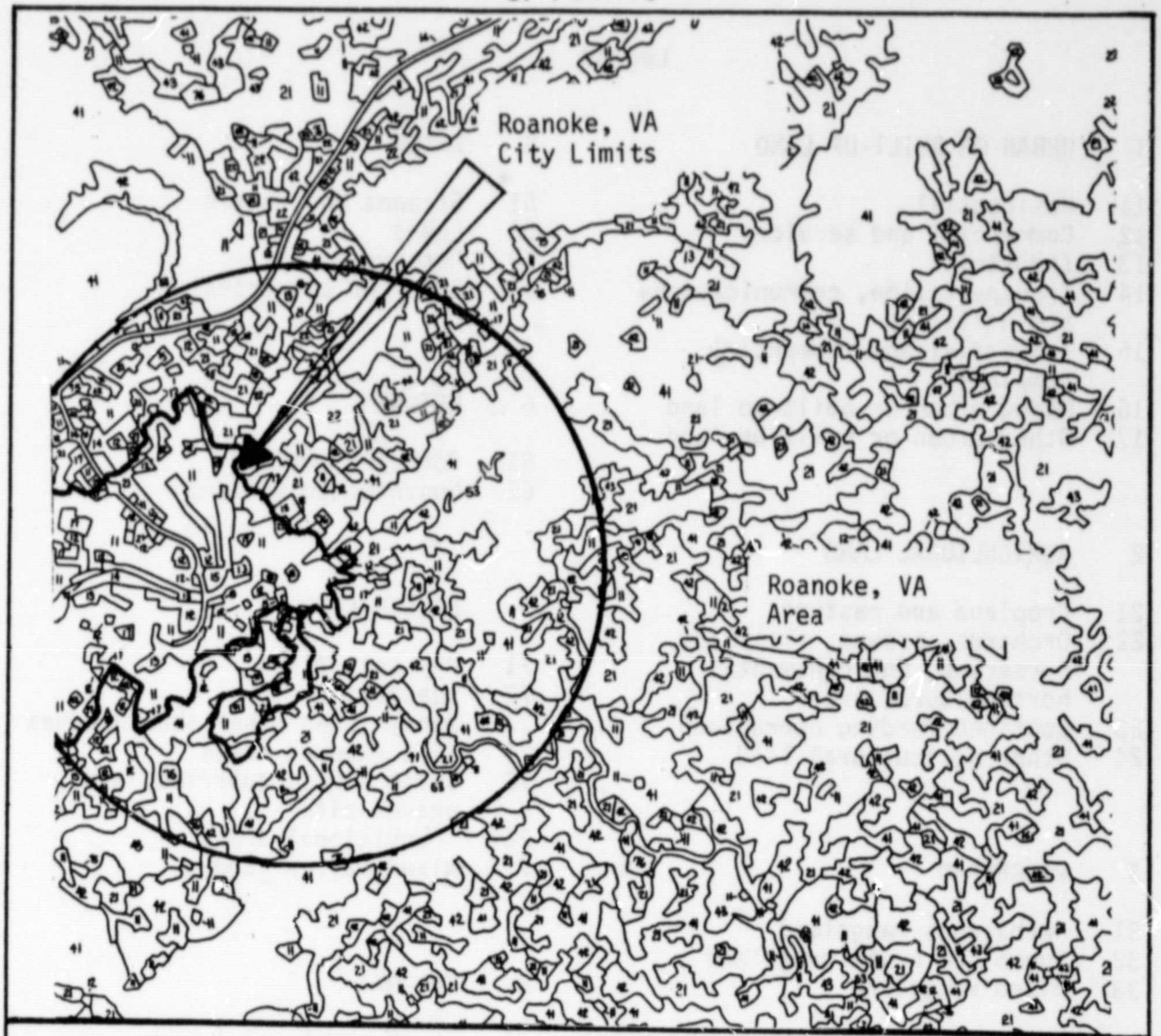

Source: USGS 1979i.

Scale: 1:250,000

FIGURE B-18
Land-Use/Land-Cover
Map for Roanoke, VA

Legend

1 URBAN OR BUILT-UP LAND

11 Residential
12 Commercial and services
13 Industrial
14 Transportation, communications and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land

2 AGRICULTURAL LAND

21 Cropland and pasture
22 Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
23 Confined feeding operations
24 Other agricultural land

3 RANGELAND

31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland

4 FOREST LAND

41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land

5 WATER

51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries

6 WETLAND

61 Forested wetland
62 Nonforested wetland

7 BARREN LAND

71 Dry salt flats
72 Beaches
73 Sandy areas other than beaches
74 Bare exposed rocks
75 Strip mines, quarries, and gravel pits
76 Transitional areas
77 Mixed barren land

8 TUNDRA

81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra

9 PERENNIAL SNOW OR ICE

91 Perennial snowfields
92 Glaciers

APPENDIX C

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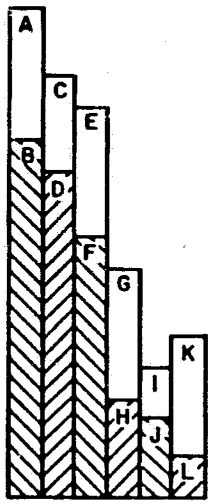

Legend

A - Total city acreage

B - Total city pond-suitable land

C - Total city developed acreage

D - Total city developed pond-suitable land

E - Total city undeveloped acreage

F - Total city undeveloped pond-suitable land

G - Total undeveloped residential acreage

H - Total undeveloped residential pond-suitable land

I - Total undeveloped commercial acreage

J - Total undeveloped commercial pond-suitable land

K - Total undeveloped institutional acreage

L - Total undeveloped institutional pond-suitable land

- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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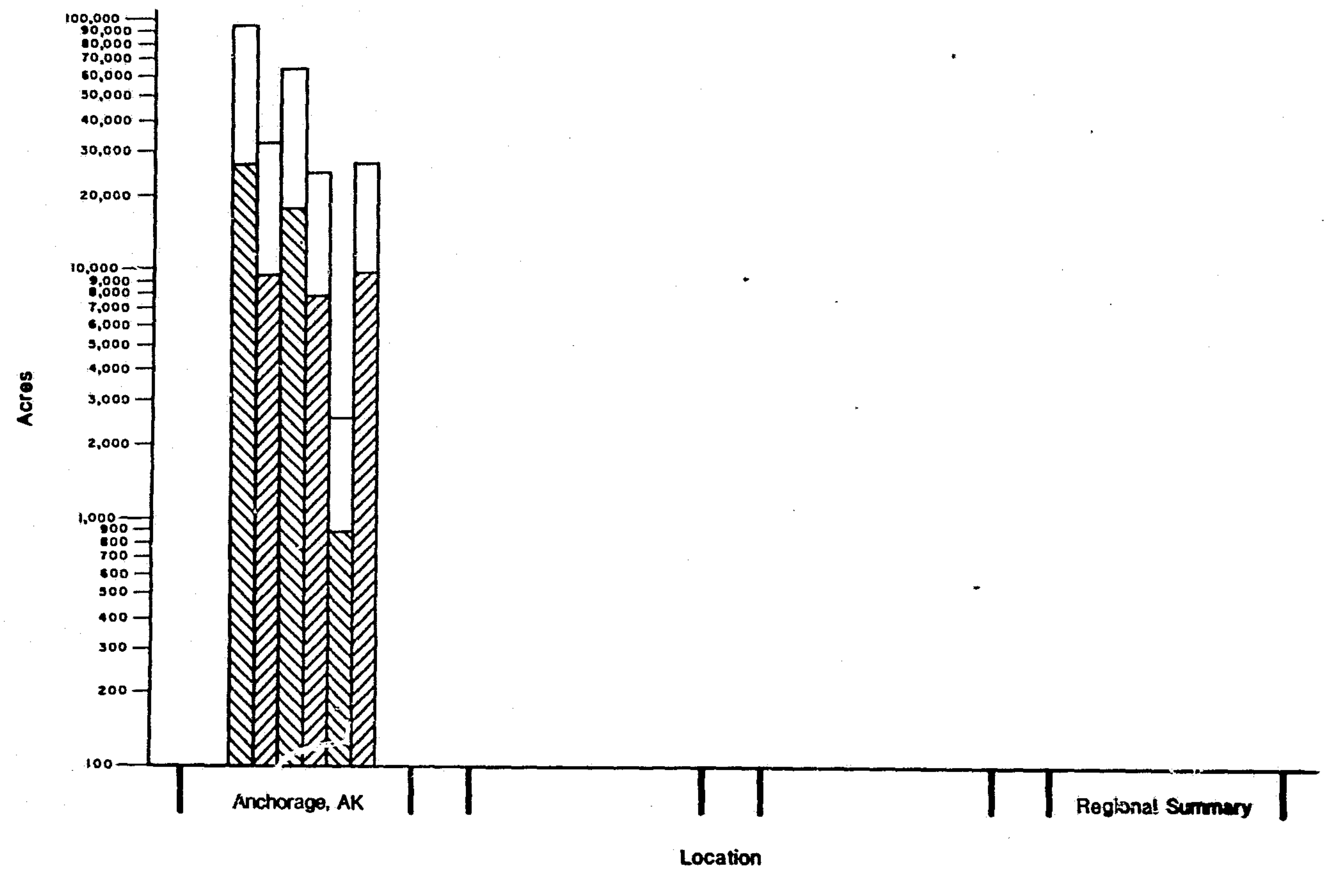
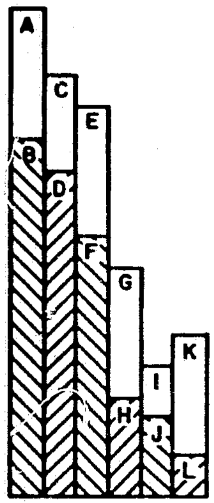


FIGURE C-1

Pond-Suitable Land Comparisons, Alaska Region

Legend



A - Total city acreage

B - Total city pond-suitable land

C - Total city developed acreage

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E - Total city undeveloped acreage

F - Total city undeveloped pond-suitable land

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- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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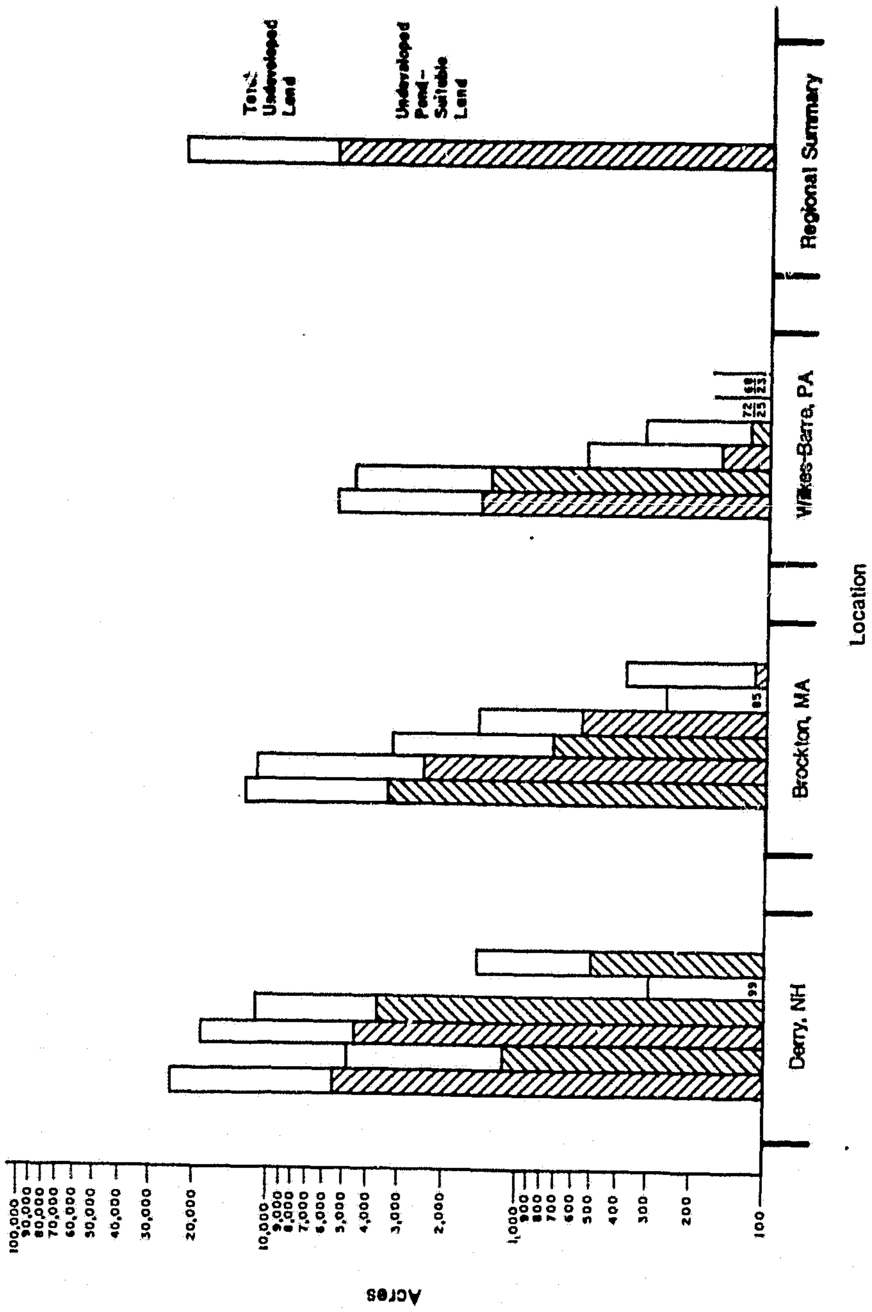
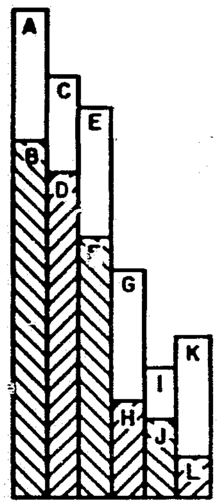


FIGURE C-2

Pond-Suitable Land Comparisons, Atlantic Northeast Region

Legend



A - Total city acreage

B - Total city pond-suitable land

C - Total city developed acreage

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E - Total city undeveloped acreage

F - Total city undeveloped pond-suitable land

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- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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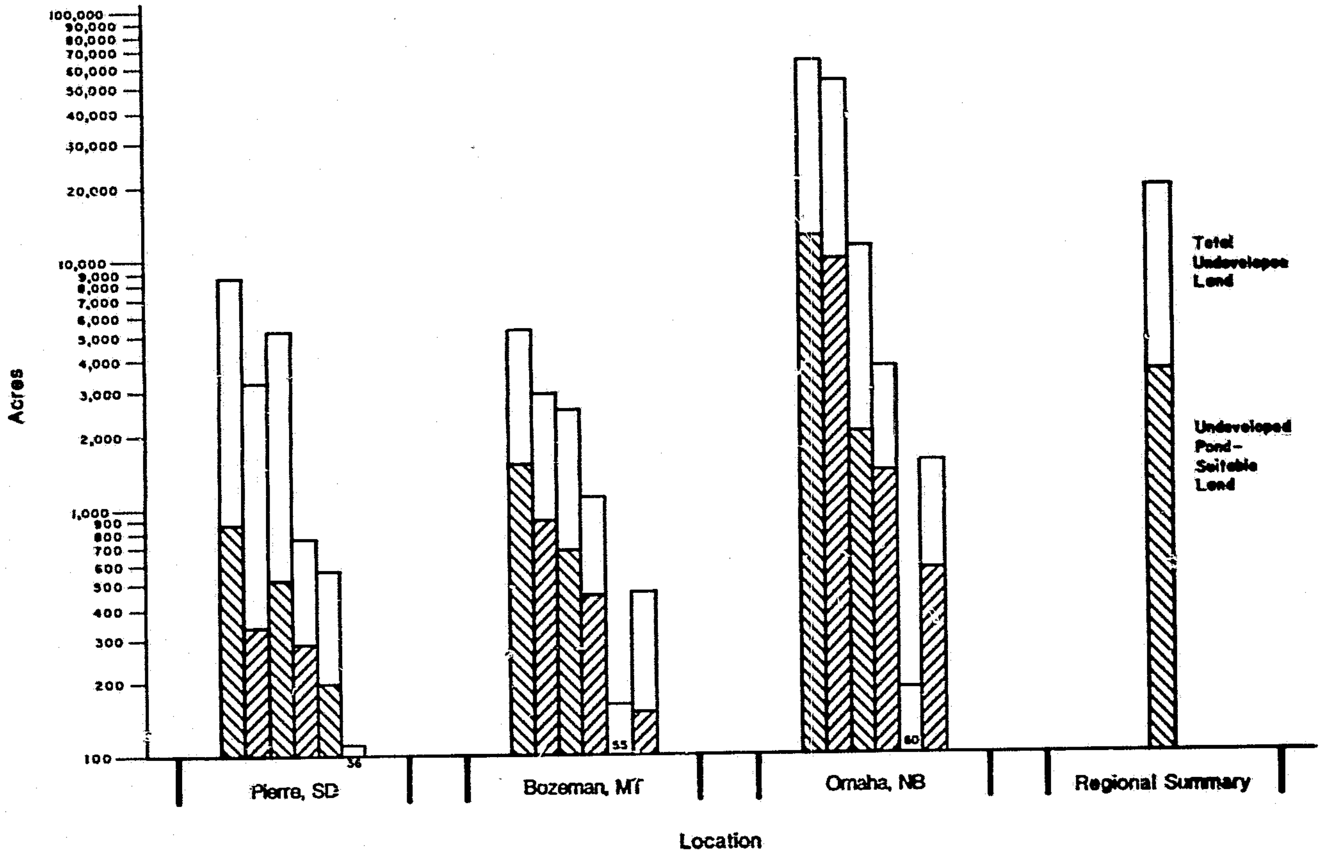
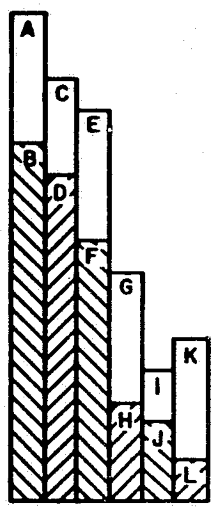


FIGURE C-3

Pond-Suitable Land Comparisons, Black Hills Region

Legend



A - Total city acreage

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K - Total undeveloped institutional acreage

L - Total undeveloped institutional pond-suitable land

40 - Estimated pond-suitable acreage is below the scale of the graph (<100)

75/25 - Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

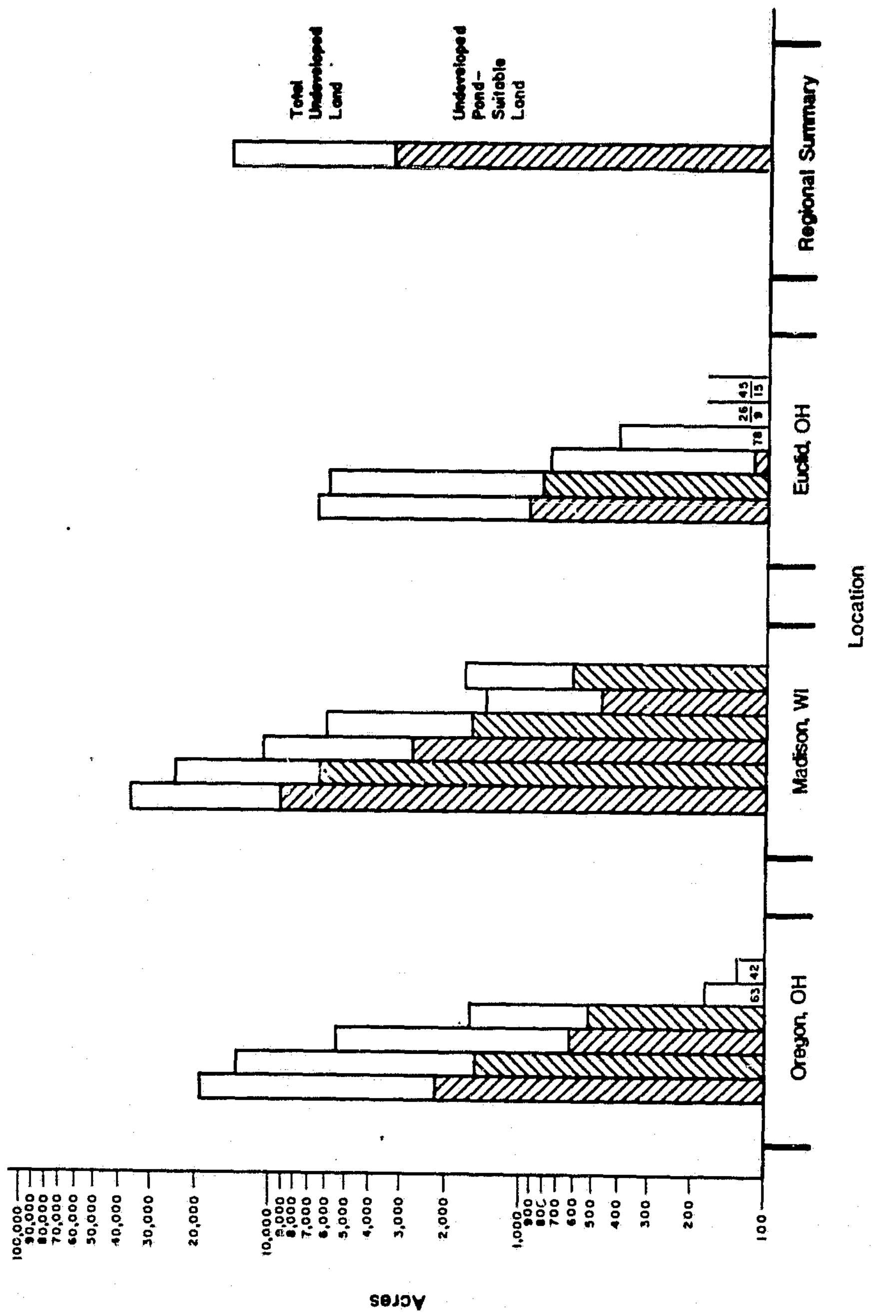
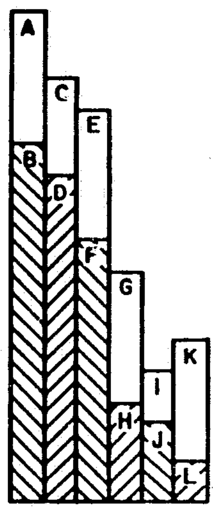


FIGURE C-4
Pond-Suitable Land Comparisons, Great Lakes Region

Legend



A - Total city acreage

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- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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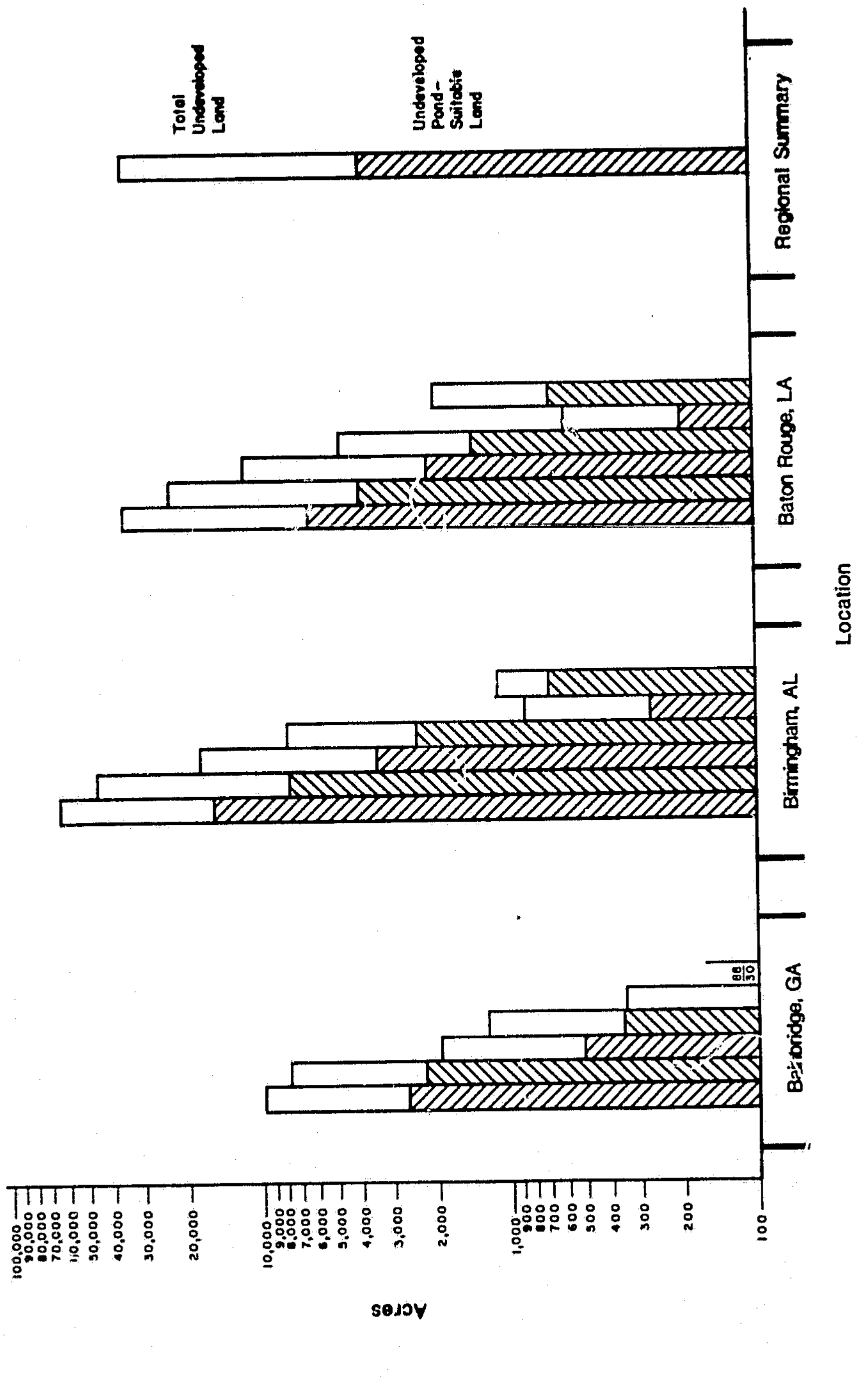
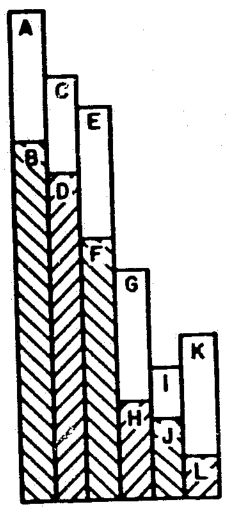


FIGURE C-5

Pond-Suitable Land Comparisons, Gulf Coast Region



Legend

A - Total city acreage

B - Total city pond-suitable land

C - Total city developed acreage

D - Total city developed pond-suitable land

E - Total city undeveloped acreage

F - Total city undeveloped pond-suitable land

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L - Total undeveloped institutional pond-suitable land

40 - Estimated pond-suitable acreage is below the scale of the graph (<100)

75/25 - Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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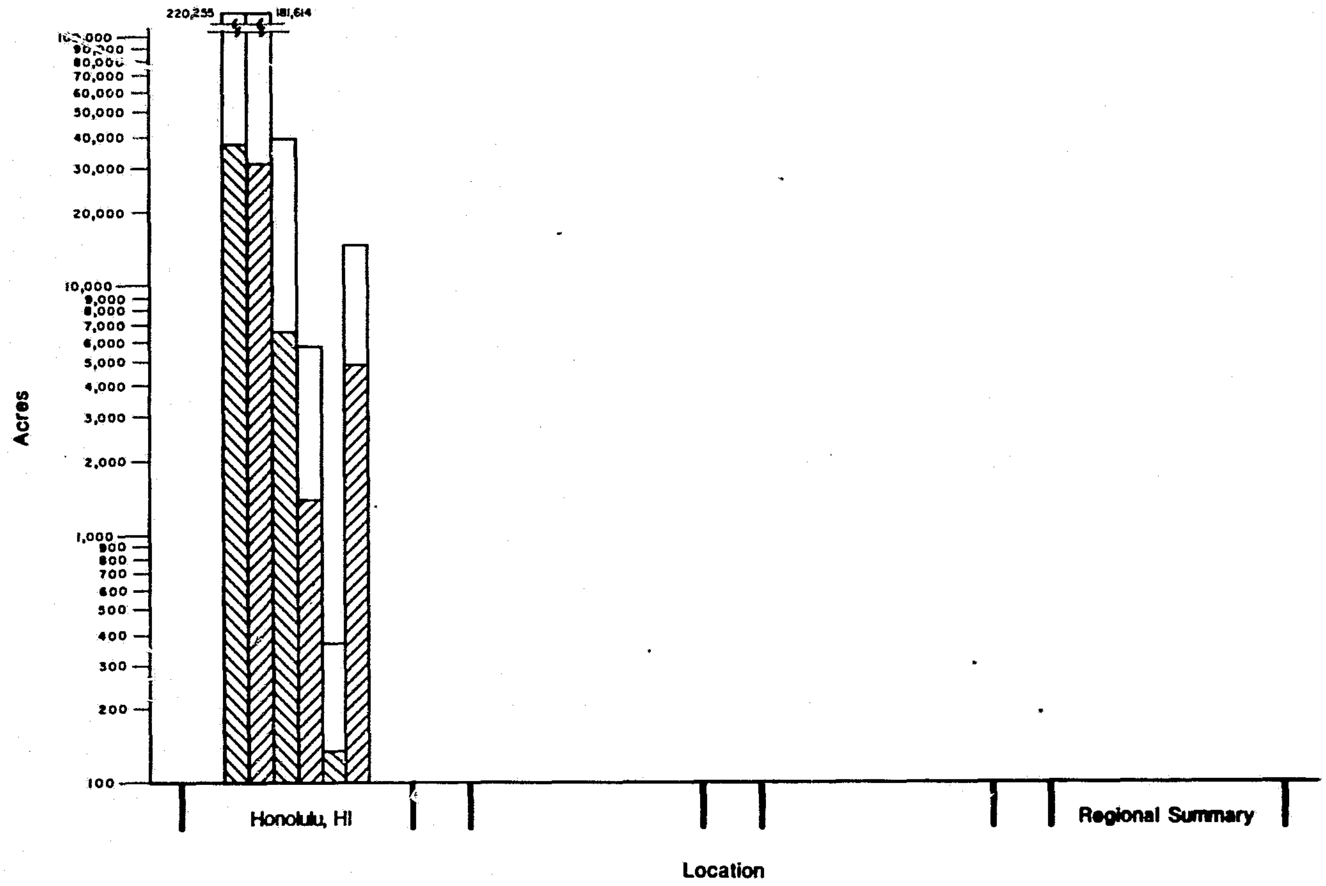
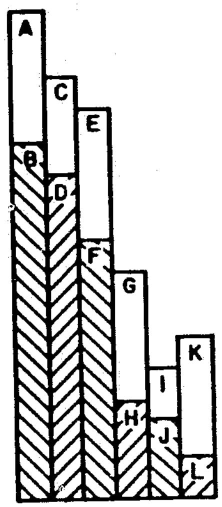


FIGURE C-6

Pond-Suitable Land Comparisons, Hawaii Region

Legend



A - Total city acreage

B - Total city pond-suitable land

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- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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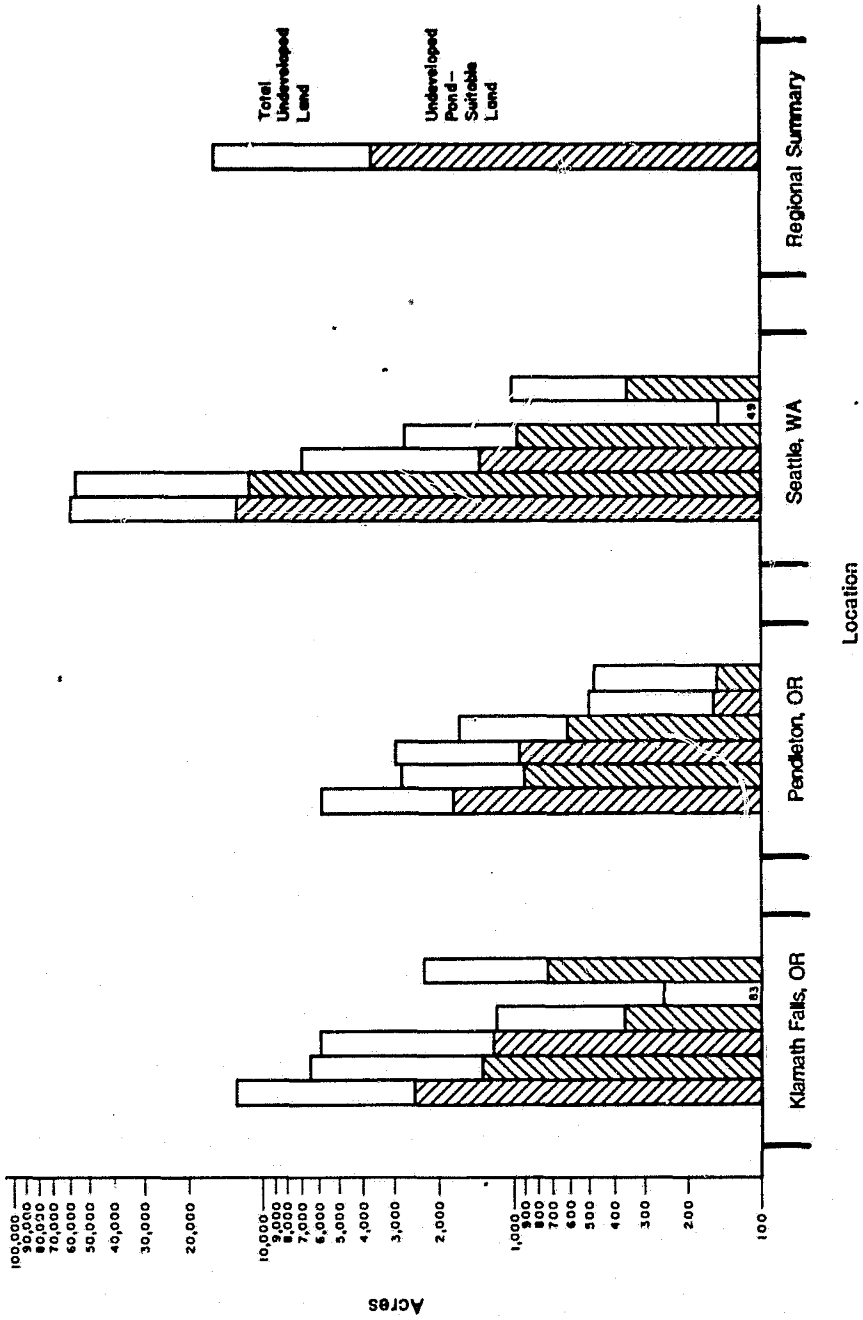

FIGURE C-7

Pond-Suitable Land Comparisons, Pacific Northwest Region

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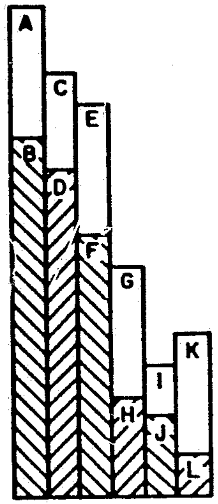

A - Total city acreage

B - Total city pond-suitable land

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D - Total city developed pond-suitable land

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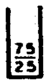
K - Total undeveloped institutional acreage

L - Total undeveloped institutional pond-suitable land

- Estimated pond-suitable acreage is below the scale of the graph (<100)



- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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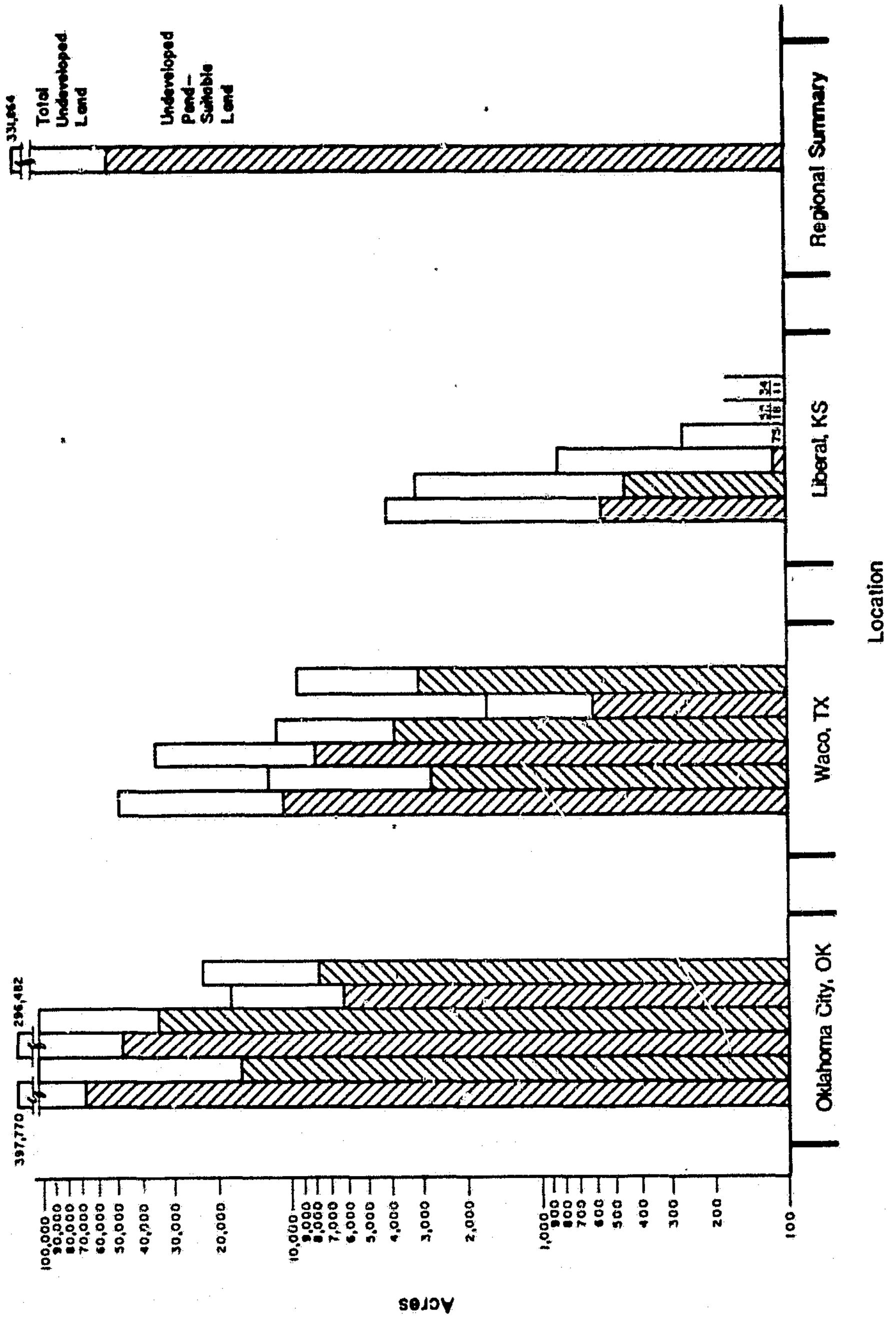
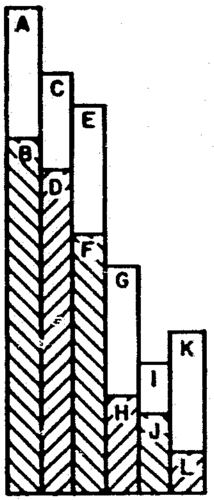


FIGURE C-8

Pond-Suitable Land Comparisons, Red River Region

Legend



A - Total city acreage

B - Total city pond-suitable land

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D - Total city developed pond-suitable land

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75/25 - Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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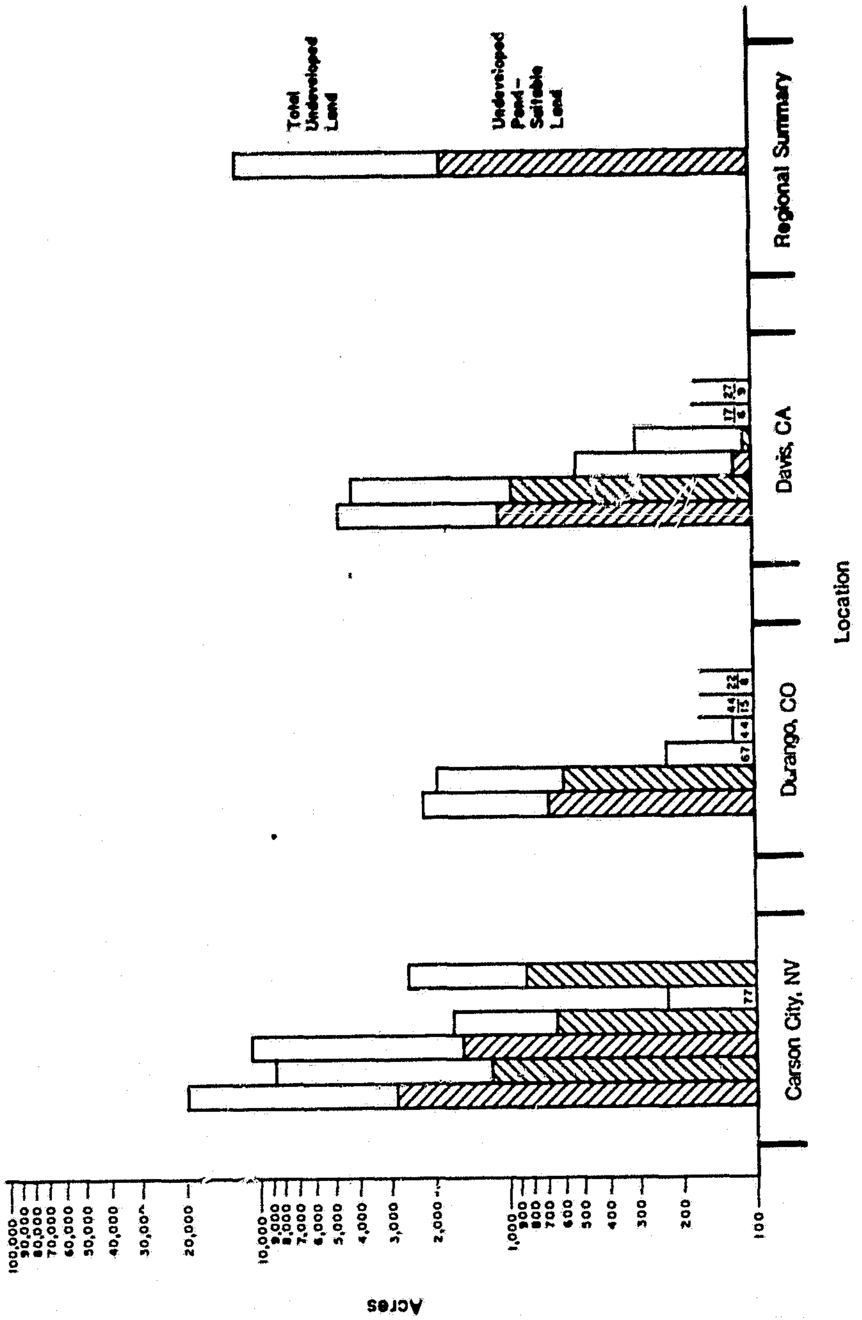
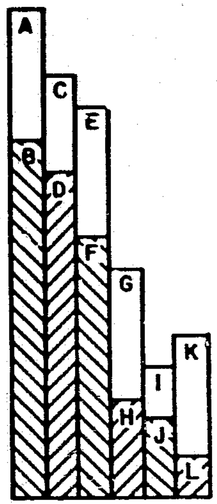


FIGURE C-9
Pond-Suitable Land Comparison, Salt Lake Region

Legend



A - Total city acreage

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- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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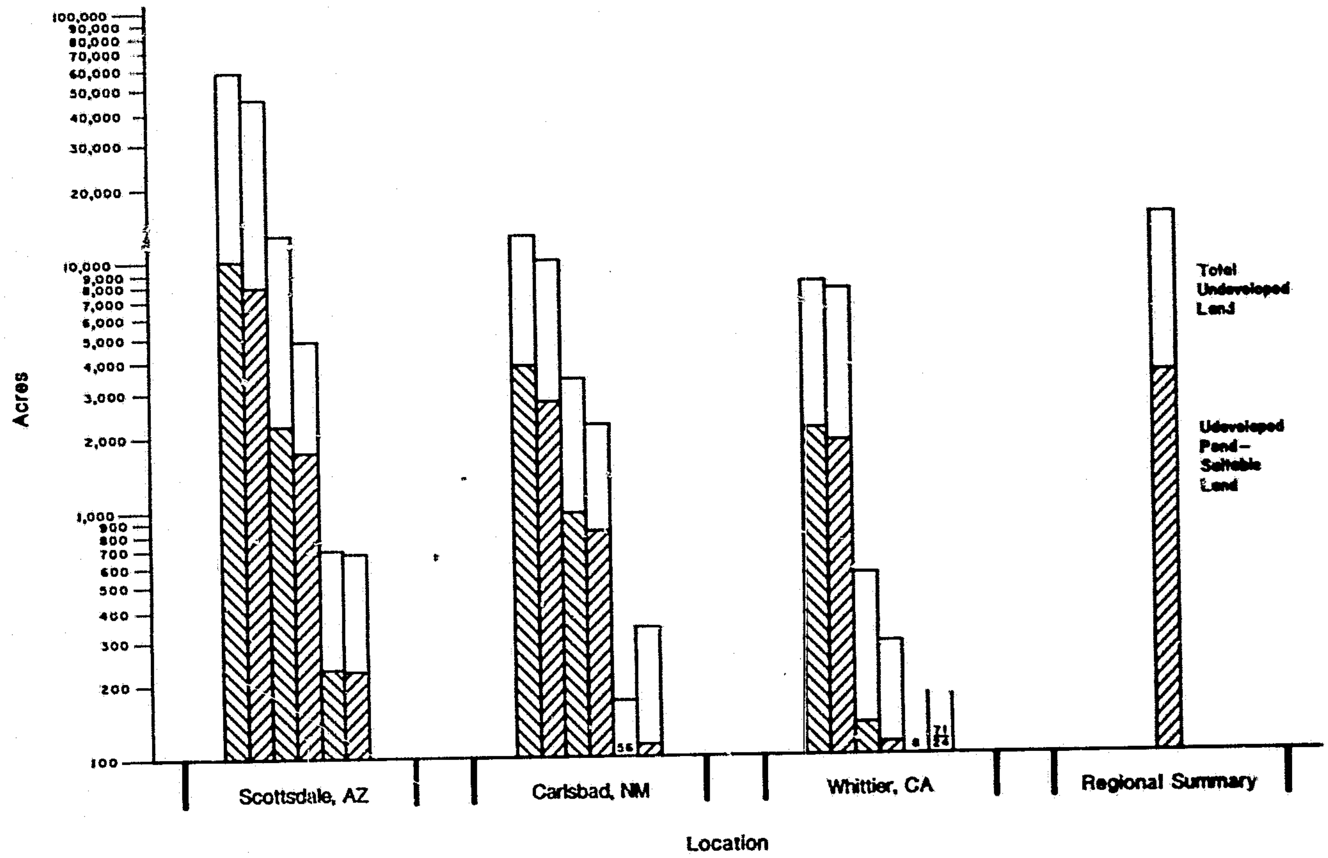

FIGURE C-10

Pond-Suitable Land Comparisons, South West Region

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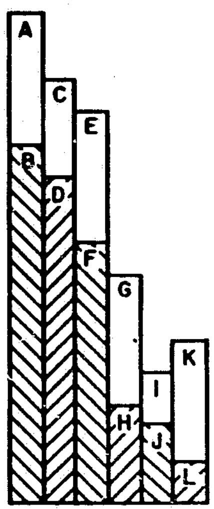

A - Total city acreage

B - Total city pond-suitable land

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- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

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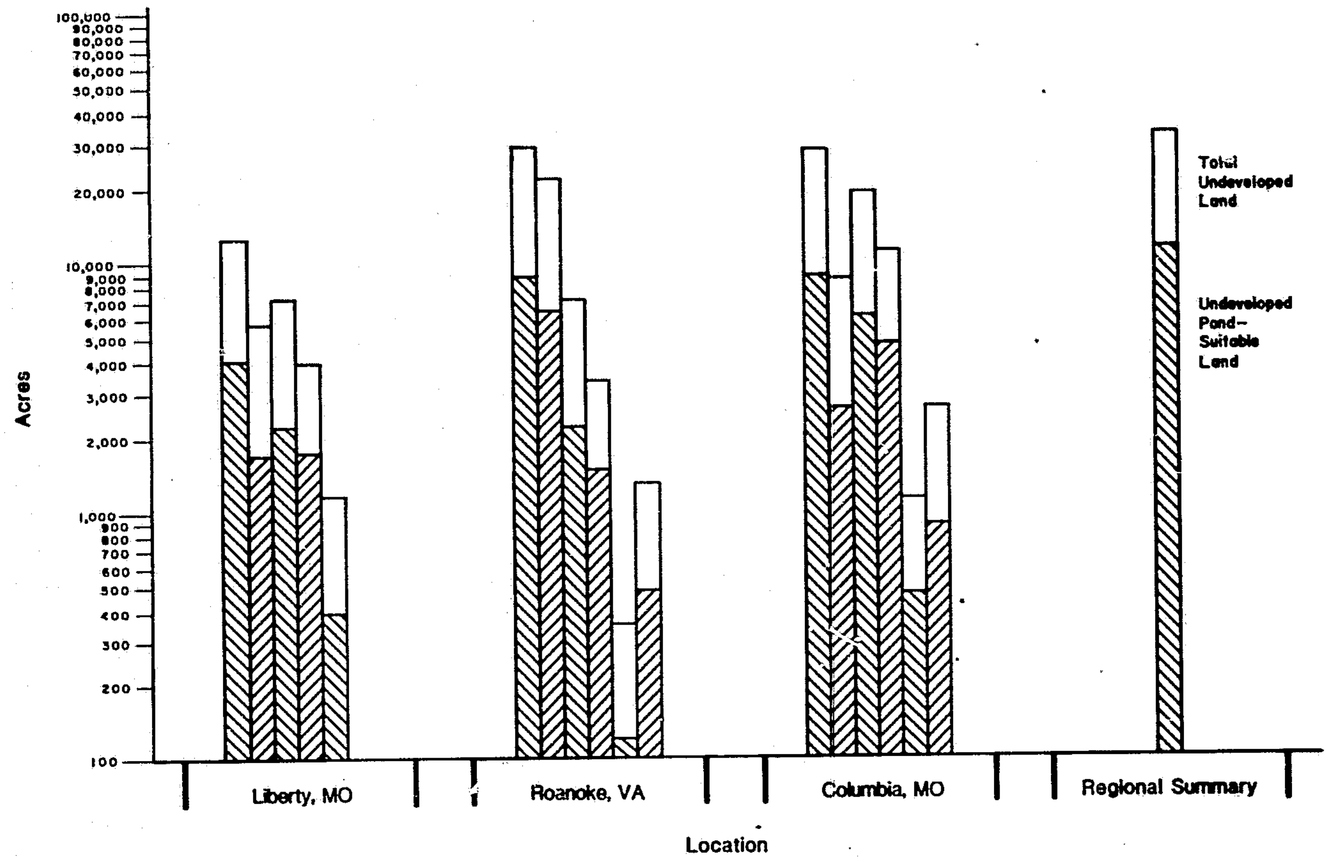


FIGURE C-11

Pond-Suitable Land Comparisons, Tennessee Valley Region

APPENDIX D

Legend

R Residential

C Commercial

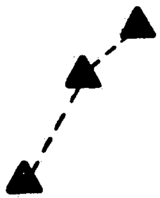
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges within development categories.



Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

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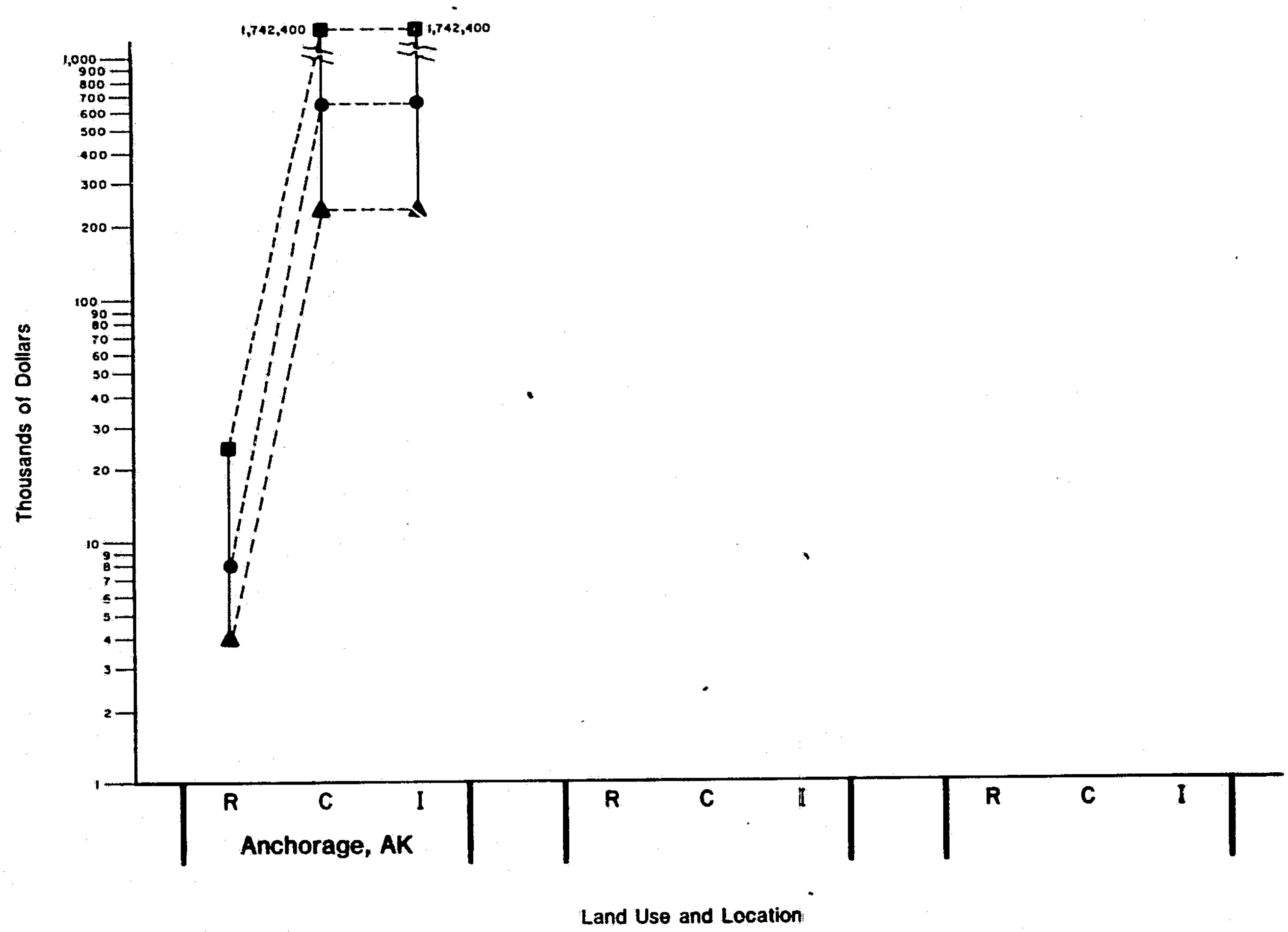


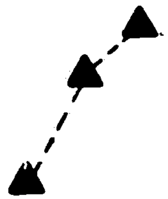
FIGURE D-1

Land-Value Comparisons, Alaska Region

Legend

R	Residential
C	Commercial
I	Institutional
▲	Low-range values
●	Medium-range values
■	High-range values

Reveals price ranges
within development categories.



Compares a given price range
among the development categories.

Note: Dollar values on a logarithmic scale.

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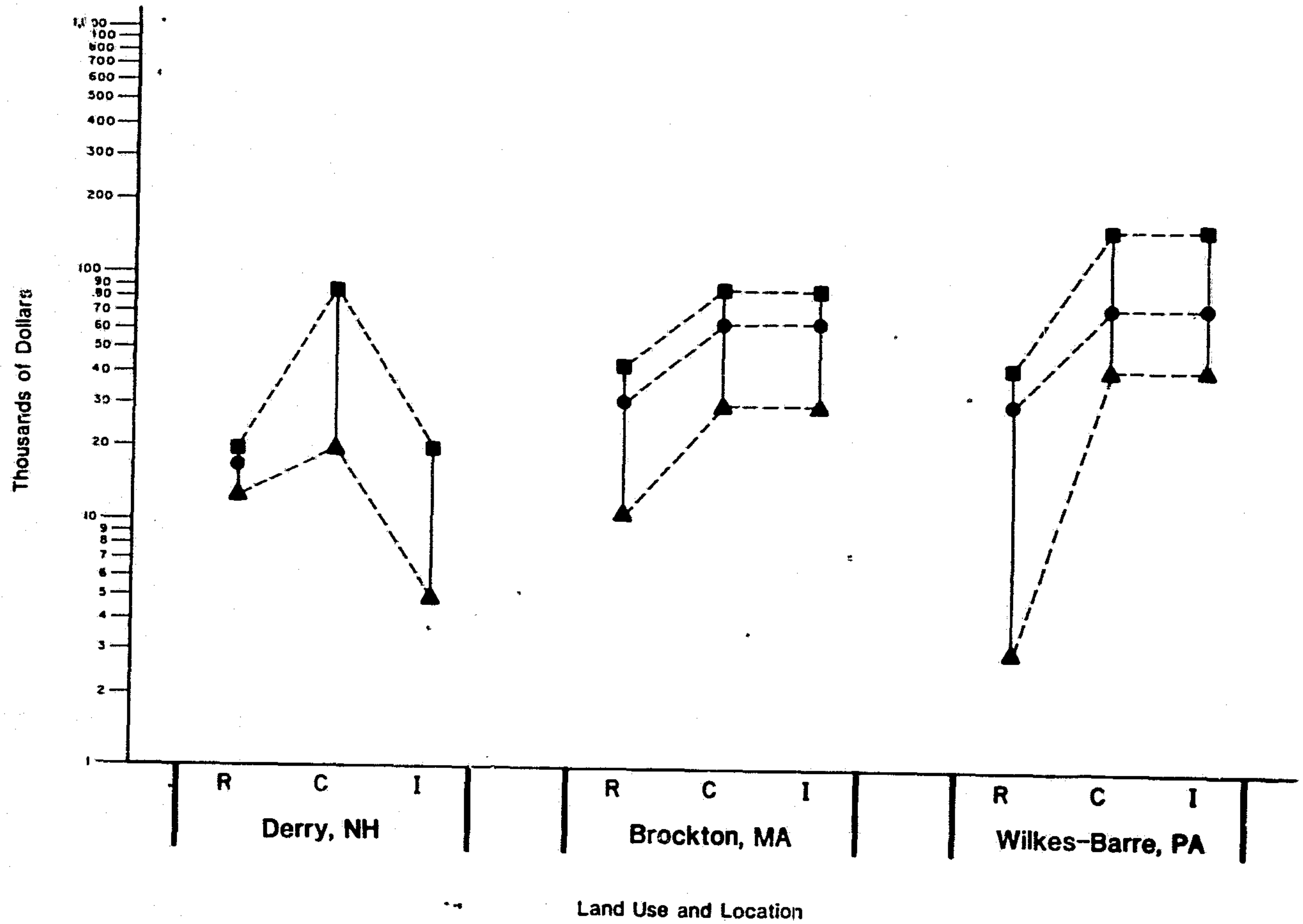


FIGURE D-2

Land-Value Comparisons, Atlantic Northeast Region

Legend

R Residential

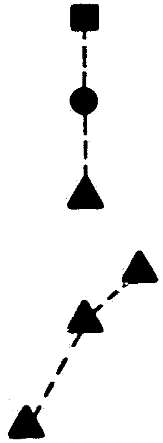
C Commercial

I Institutional

▲ Low-range values

● Medium-range values

■ High-range values



Reveals price ranges within development categories.

Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

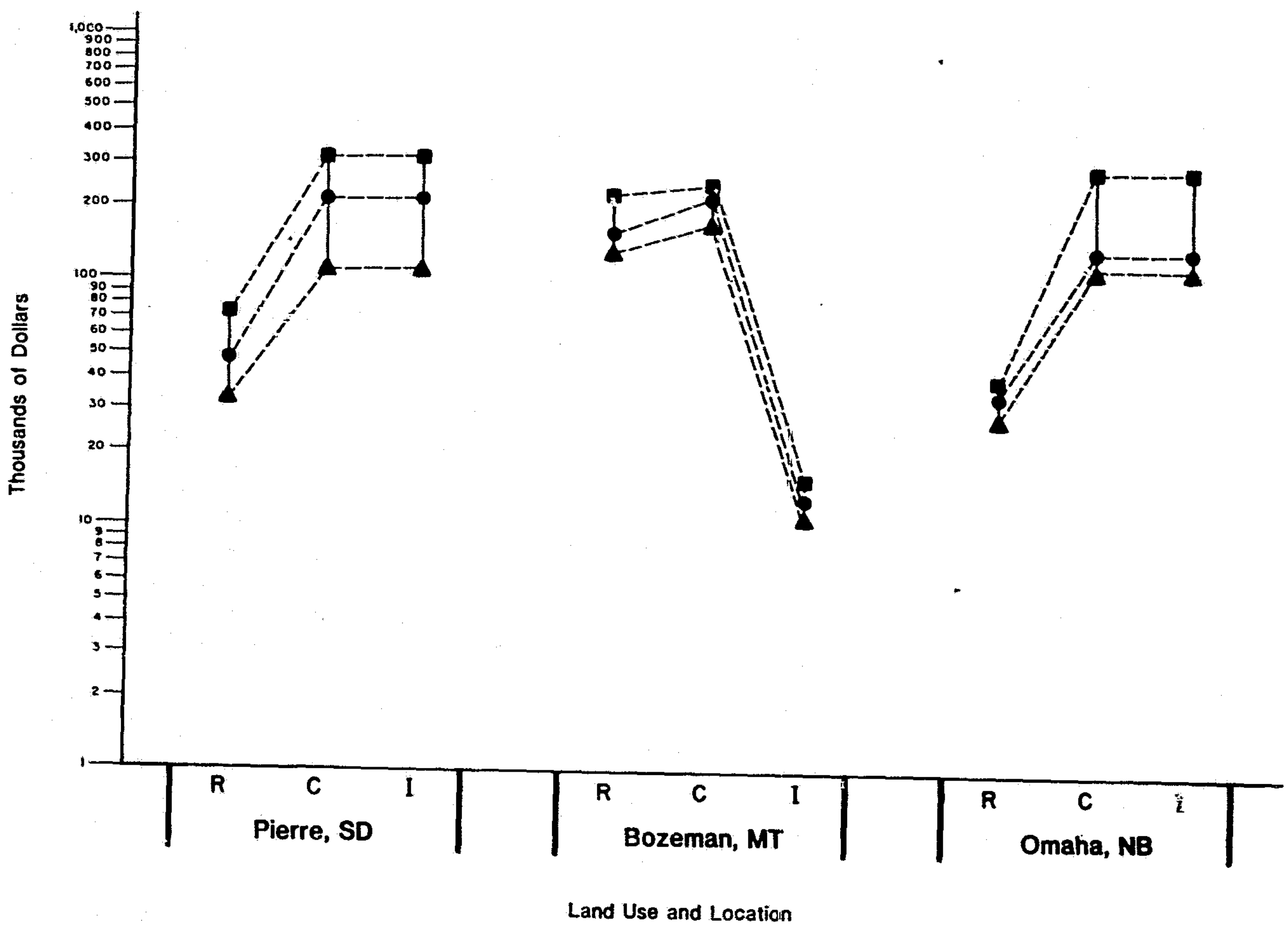


FIGURE D-3

Land-Value Comparisons, Black Hills Region

Legend

R Residential

C Commercial

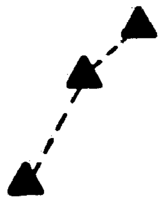
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges within development categories.



Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

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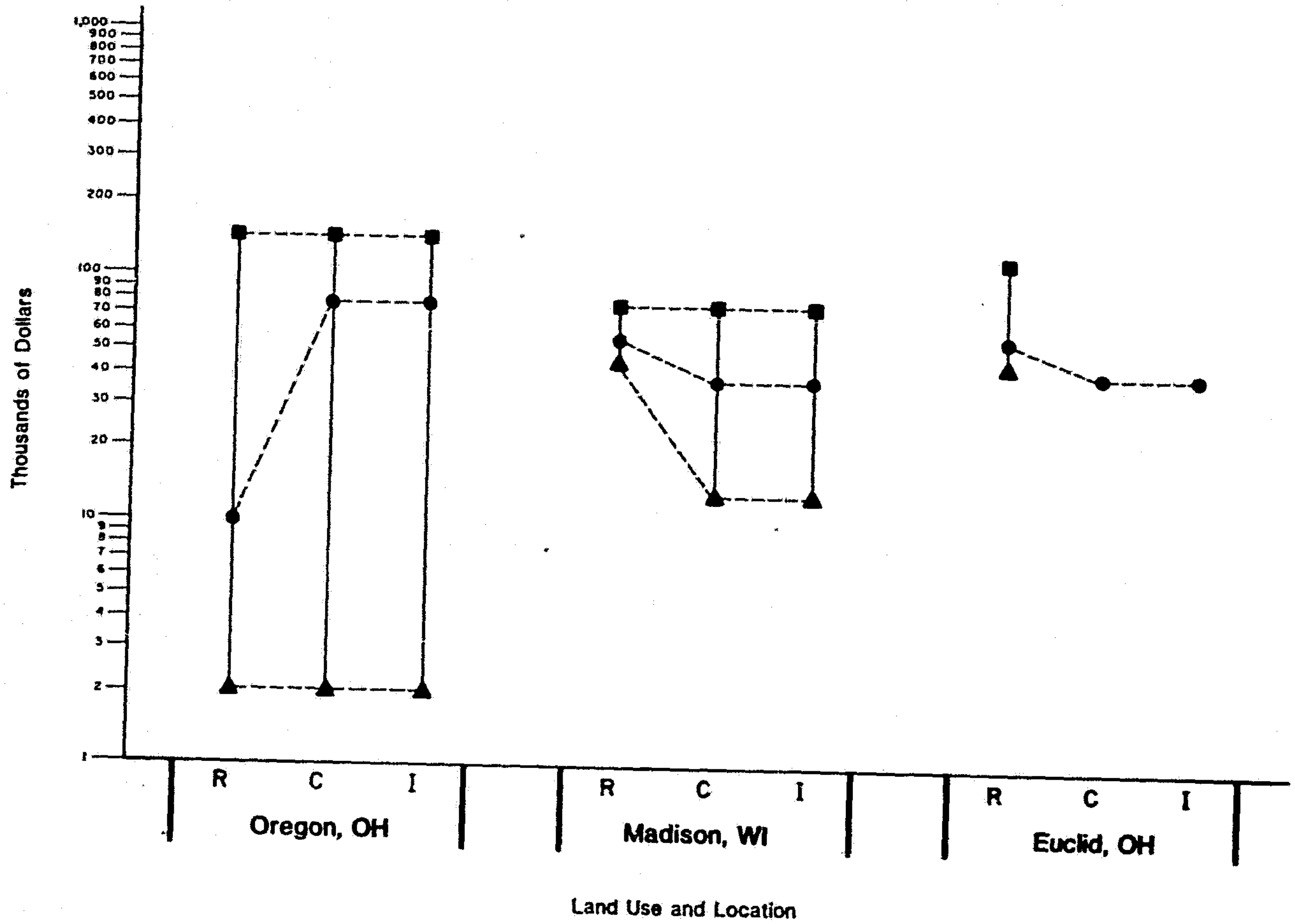


FIGURE D-4

Land-Value Comparisons, Great Lakes Region

Legend

R Residential

C Commercial

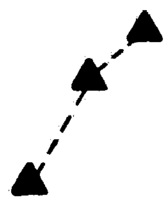
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges within development categories.



Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

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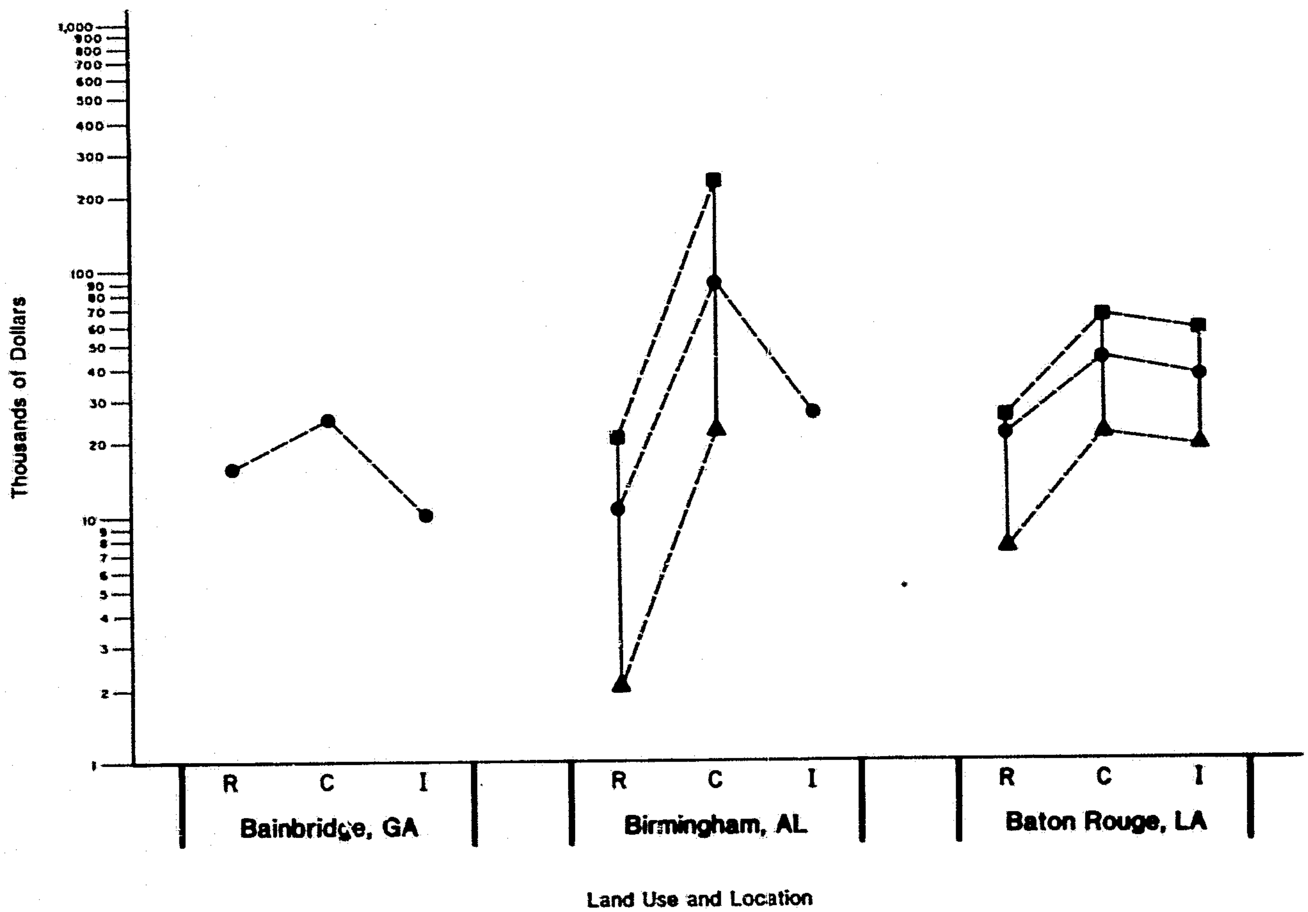
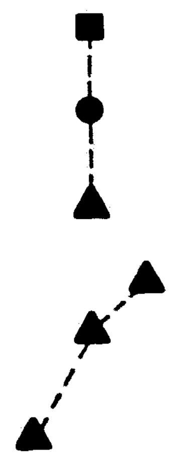


FIGURE D-5

Land-Value Comparisons, Gulf Coast Region

Legend

R	Residential
C	Commercial
I	Institutional
▲	Low-range values
●	Medium-range values
■	High-range values



Reveals price ranges within development categories.

Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

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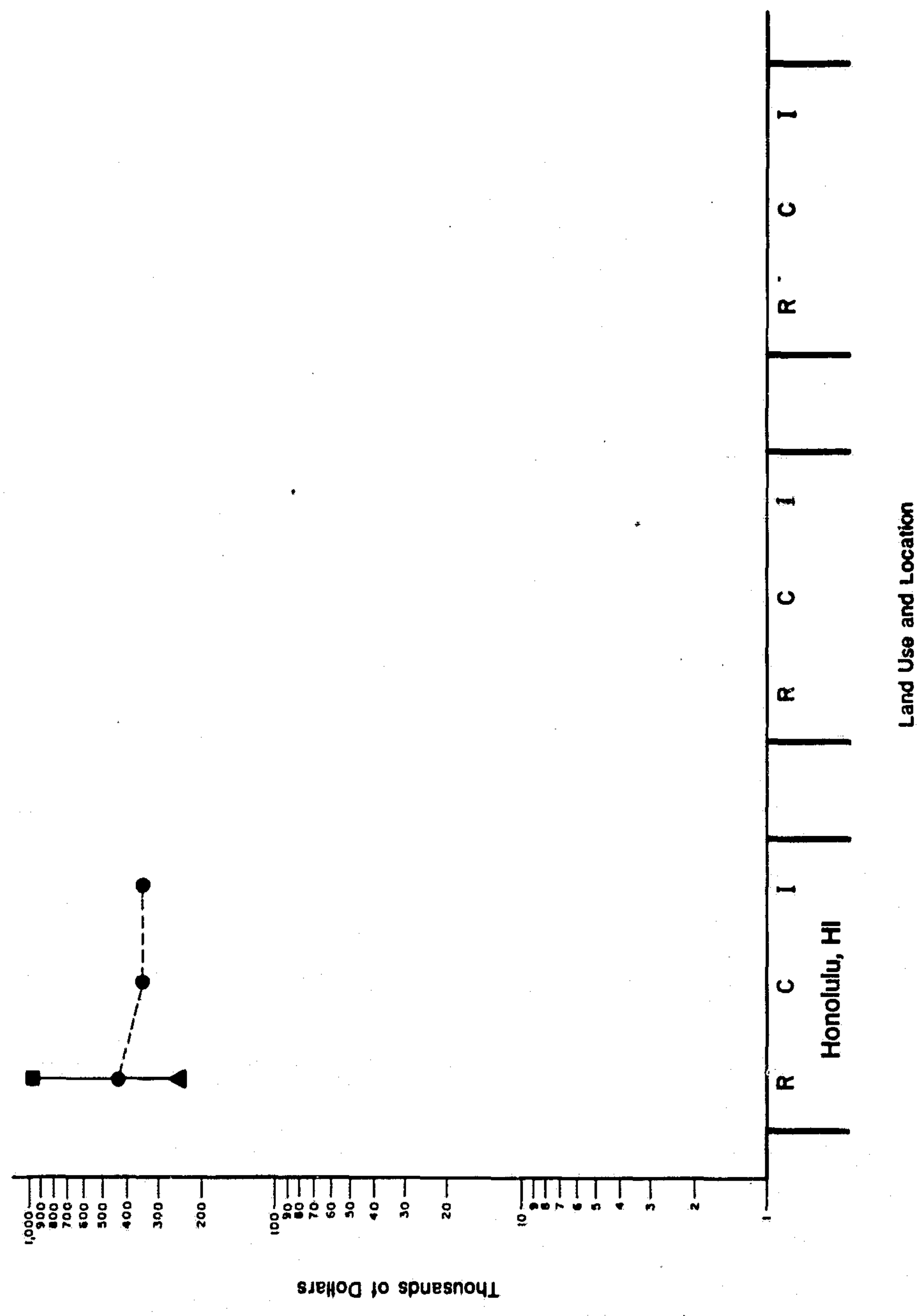


FIGURE D-6

Land-Value Comparisons, Hawaii Region

Legend

R Residential

C Commercial

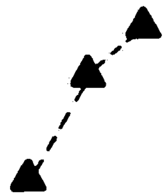
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges
within development categories.



Compares a given price range
among the development categories.

Note: Dollar values on a logarithmic
scale.

ORIGINAL PAGE IS
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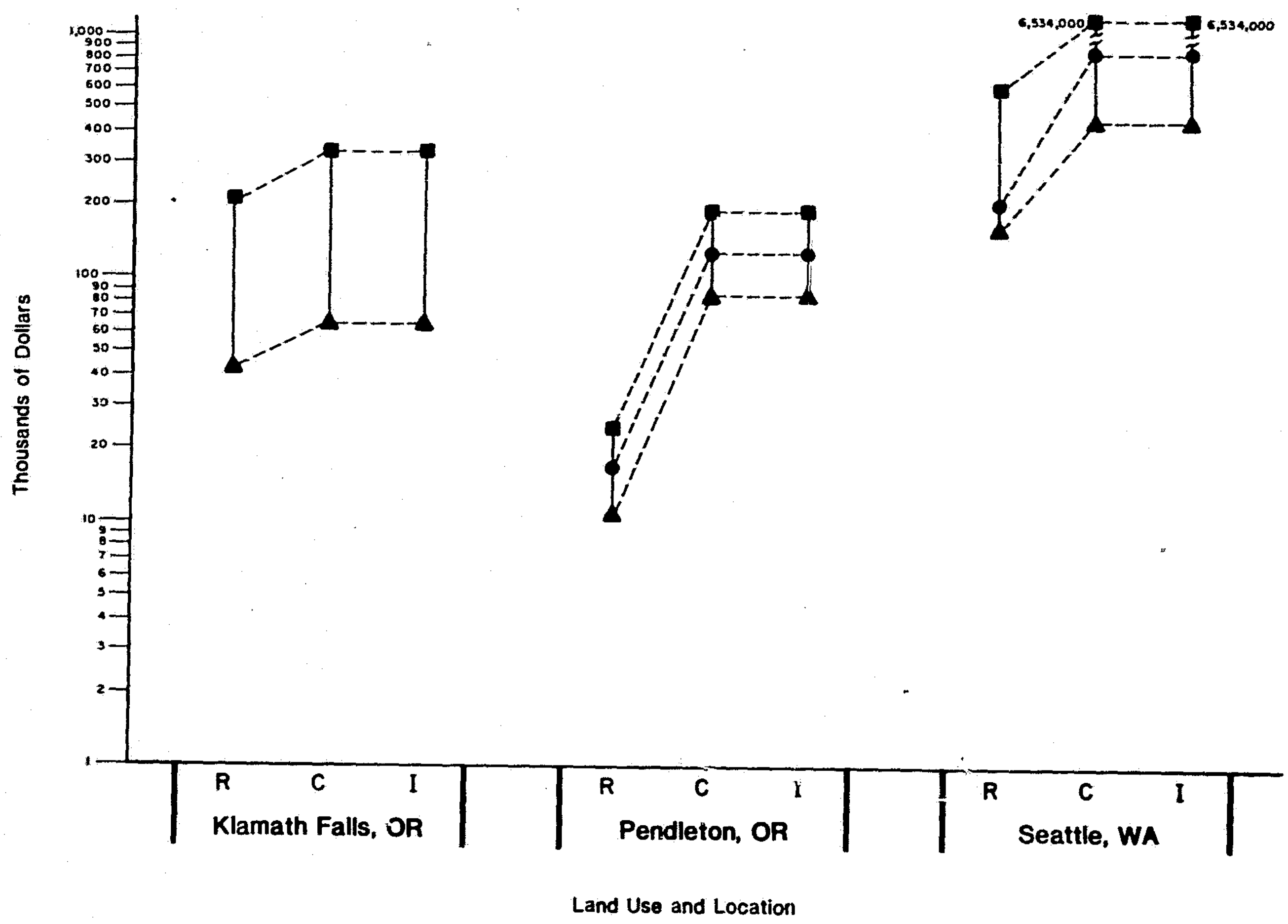


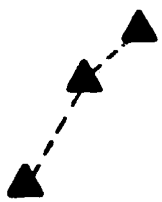
FIGURE D-7

Land-Value Comparisons, Pacific Northwest Region

Legend

R	Residential
C	Commercial
I	Institutional
▲	Low-range values
●	Medium-range values
■	High-range values

Reveals price ranges
within development categories.



Compares a given price range
among the development categories.

Note: Dollar values on a logarithmic scale.

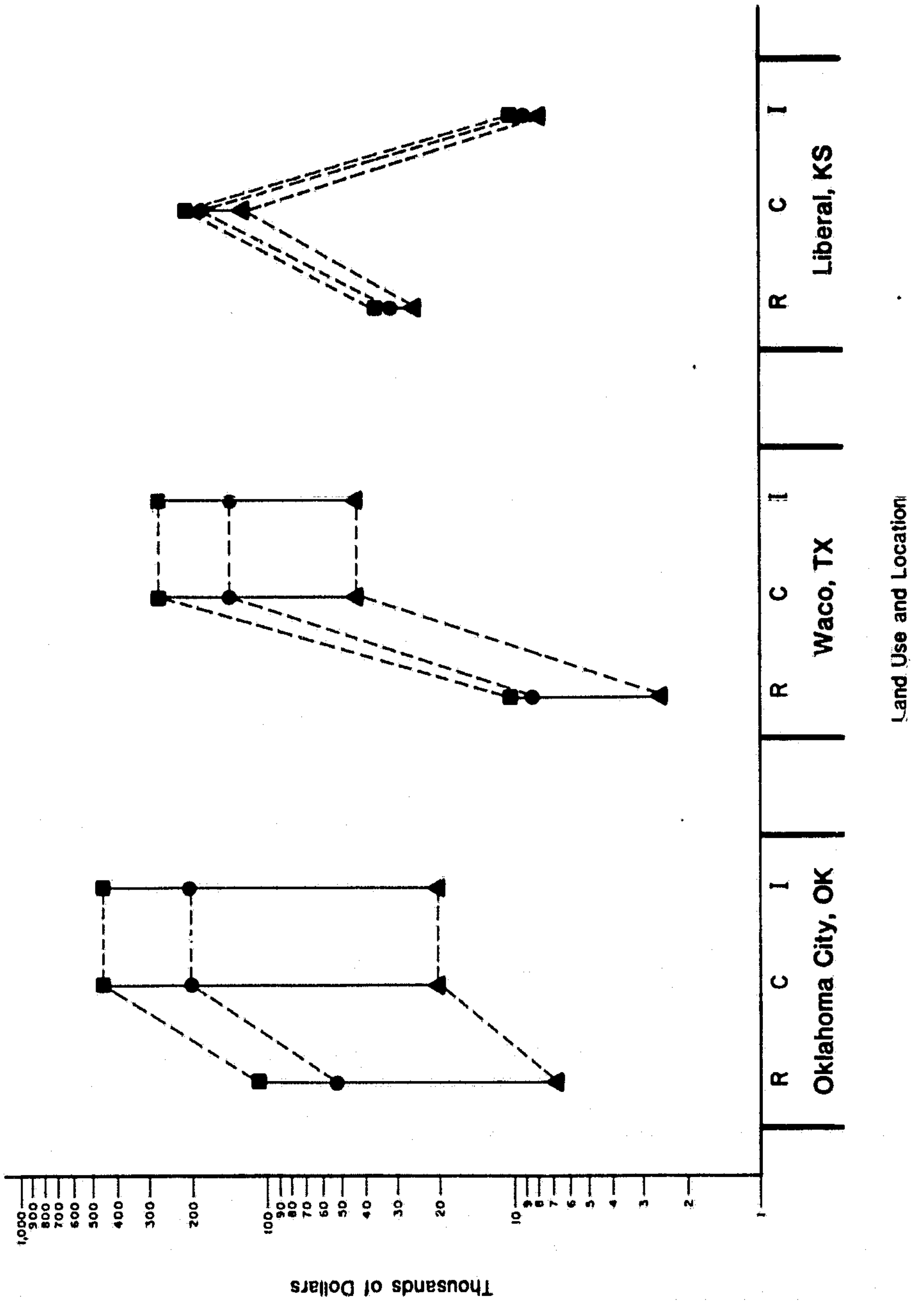


FIGURE D-8
Land-Value Comparisons, Red River Region

Legend

R	Residential
C	Commercial
I	Institutional
▲	Low-range values
●	Medium-range values
■	High-range values

■ - - ● - - ▲ Reveals price ranges within development categories.

▲ - - ▲ - - ▲ Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

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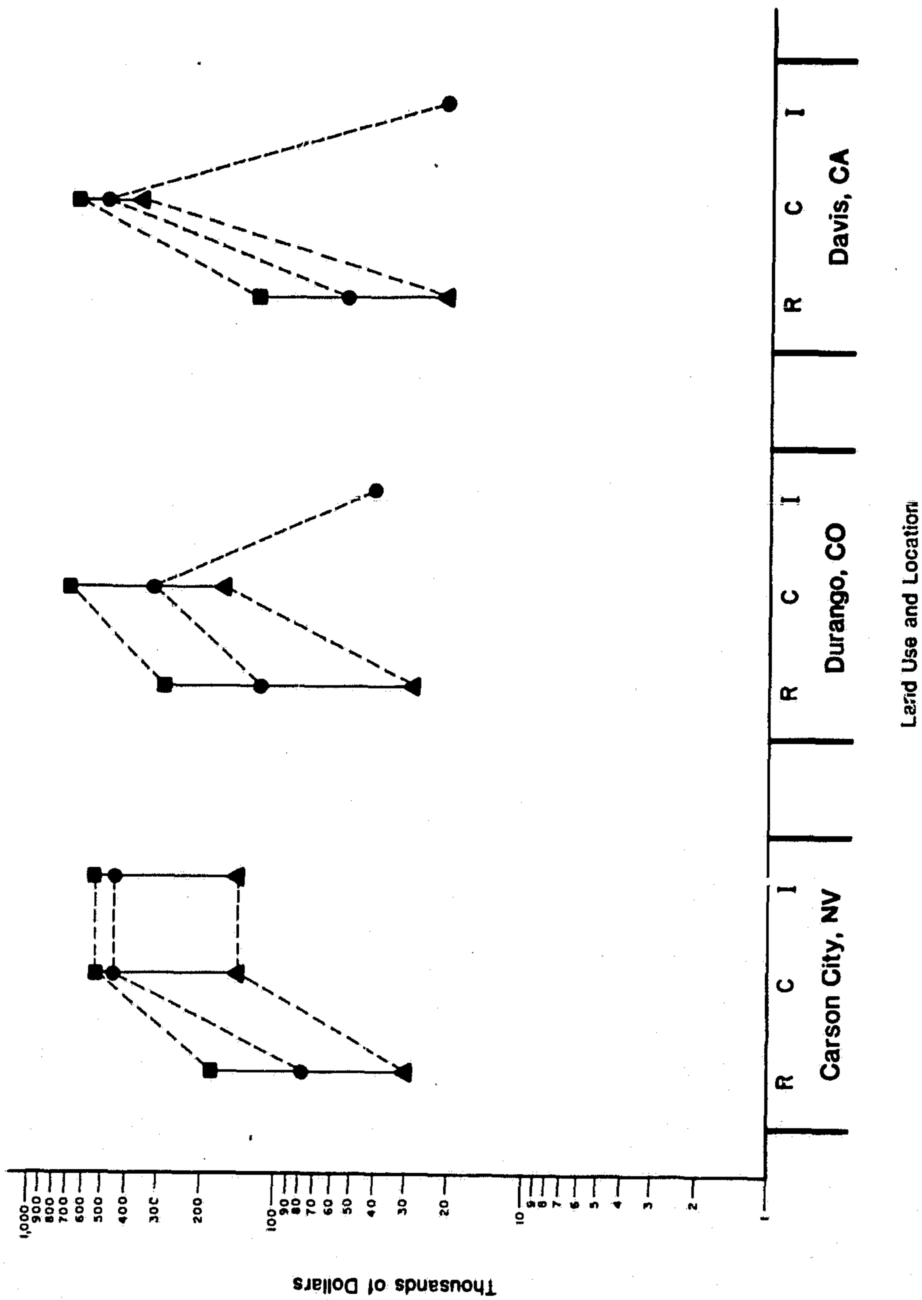


FIGURE D-9

Land-Value Comparisons, Salt Lake Region

Legend

R Residential

C Commercial

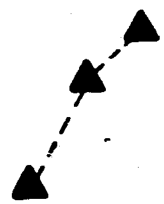
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges within development categories.



Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

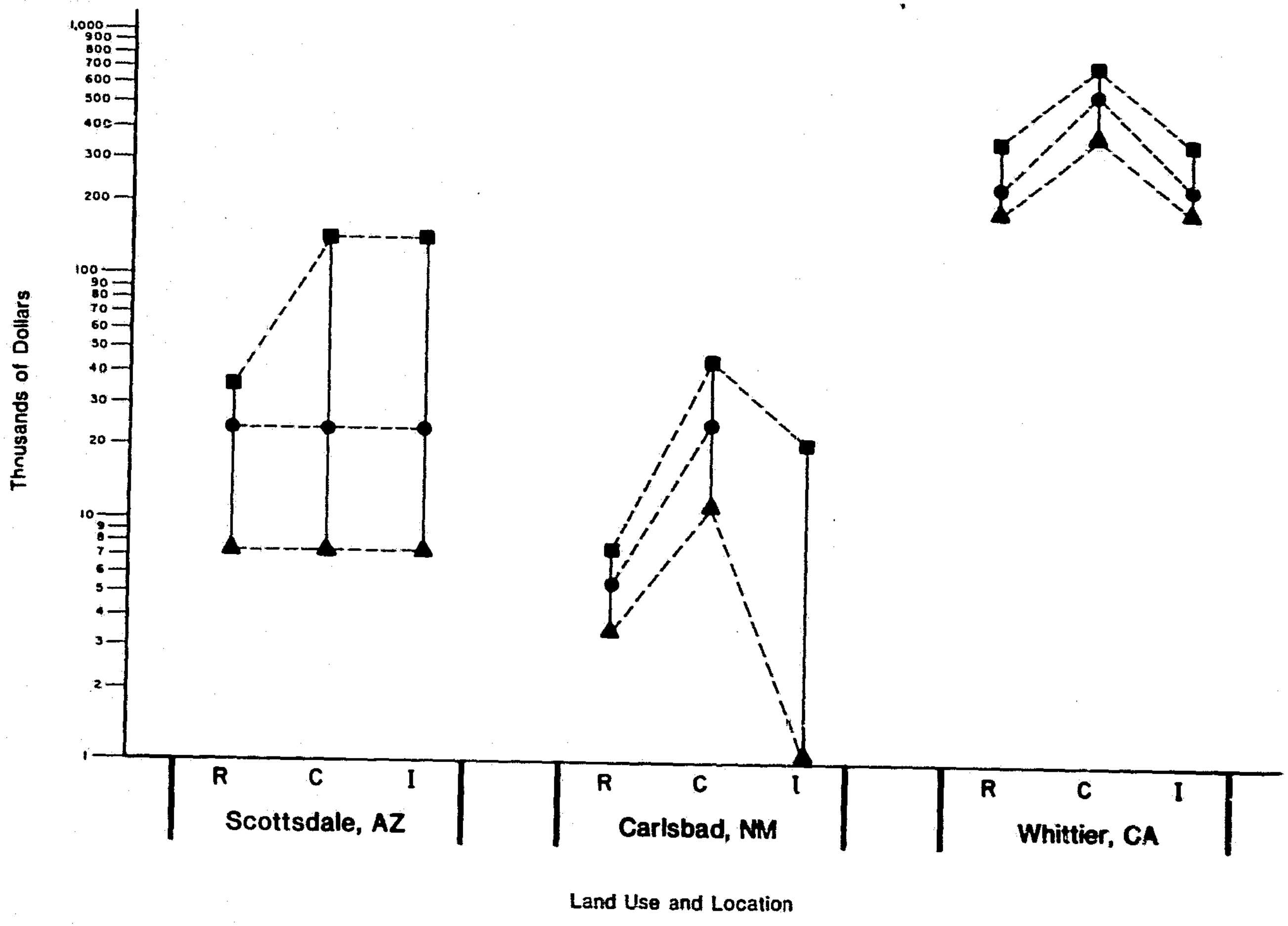


FIGURE D-10

Land-Value Comparisons, South West Region

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Legend

R Residential

C Commercial

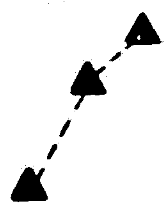
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges within development categories.



Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

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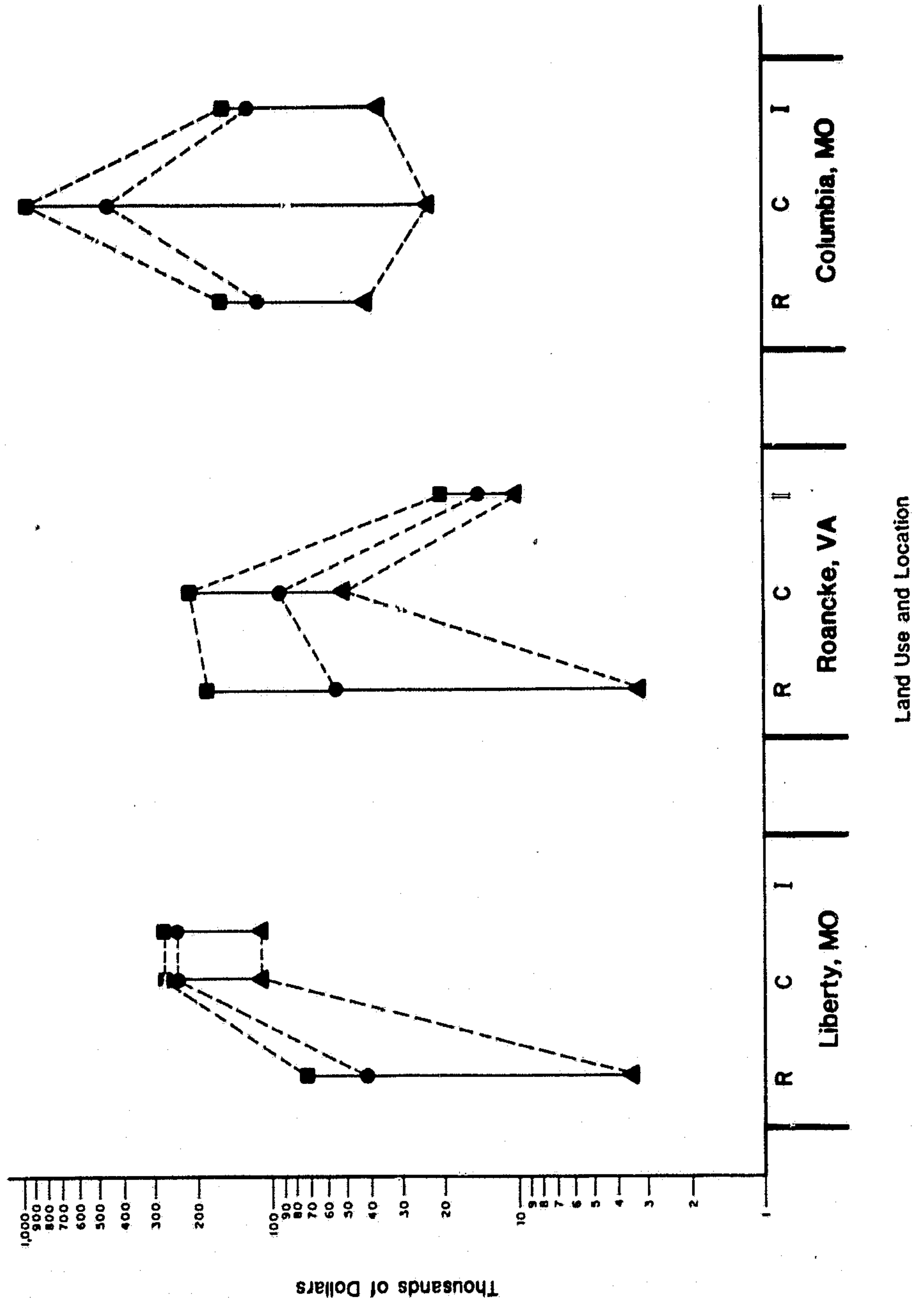

FIGURE D-11

Land-Value Comparisons, Tennessee Valley Region

APPENDIX E

EXHIBIT A

Average Size of Finished Residential Lots by States 1976-1980 (in square feet)

State	1976	1977	1978	1979	1980
Maine	32,913	45,200	44,048	42,236	42,168
Rhode Island	—	—	—	33,604	35,684
Massachusetts	—	—	25,752	29,223	30,473
Connecticut	28,654	33,285	33,487	32,360	30,268
Delaware	11,042	12,125	14,736	22,596	25,052
N. Hampshire	37,061	40,572	24,556	25,843	21,832
Vermont	—	—	20,159	29,835	21,723
Pennsylvania	18,499	19,039	19,489	19,697	20,192
N. Carolina	23,388	17,752	18,713	19,421	19,498
Georgia	19,163	18,624	19,530	18,823	18,277
N. York	13,733	13,239	22,709	17,587	17,698
Alabama	14,892	16,743	18,391	17,344	16,973
W. Virginia	14,486	14,841	16,279	14,664	16,552
N. Jersey	19,934	16,880	16,049	16,480	16,083
Wisconsin	16,485	17,166	16,121	16,221	15,867
Tennessee	13,523	13,410	16,396	15,720	15,487
Minnesota	14,288	15,200	14,911	14,593	14,810
Indiana	15,386	15,472	13,341	14,964	14,366
S. Carolina	—	11,103	12,919	13,407	14,356
Michigan	14,098	15,467	14,621	13,609	14,189
Maryland	13,715	14,365	16,309	15,387	13,779
Virginia	13,719	14,511	12,987	13,186	13,726
S. Dakota	9,467	10,909	14,373	17,575	13,476
Ohio	15,573	15,377	15,200	14,009	13,438
Mississippi	—	10,100	14,772	13,022	12,630
Missouri	10,636	11,283	11,422	11,709	12,012
Washington	11,316	11,733	10,721	11,948	11,870
Iowa	9,536	10,662	10,990	10,909	11,659
Kentucky	11,251	11,387	12,661	12,523	11,629
Montana	—	—	14,492	11,453	11,512
Louisiana	13,046	13,139	11,086	10,863	11,454
Florida	10,706	10,899	10,861	10,697	10,785
Kansas	11,080	11,224	11,405	10,956	10,767
Oklahoma	12,335	12,496	12,315	11,622	10,745
N. Dakota	—	—	—	14,783	10,707
Illinois	9,754	10,768	10,071	10,485	10,545
Texas	9,971	9,354	9,420	10,122	10,039
Idaho	12,712	11,330	10,922	10,185	9,883
Arkansas	—	11,335	16,512	—	9,871
N. Mexico	11,010	8,637	9,613	9,470	9,776
Utah	8,009	8,775	9,344	9,674	9,592
Oregon	9,779	8,798	8,974	9,108	9,265
Nebraska	9,198	9,266	9,122	9,074	8,958
Colorado	8,739	8,694	8,740	8,745	8,590
California	10,192	9,644	9,592	9,633	8,378
Alaska	—	—	—	9,605	8,071
Nevada	13,358	9,391	10,145	15,267	7,352
Hawaii	—	—	—	—	5,901
Washington, D.C.	—	—	—	2,323	3,974
Wyoming	—	—	—	—	—
Arizona	—	—	—	—	—
U.S. Total	11,589	12,241	12,364	12,828	12,807

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Source: Homer Hoyt Institute 1981.

EXHIBIT B

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Average Cost of Finished Residential Lots by States 1976-1980

State	1976	1977	1978	1979	1980
Hawaii	$ —	$ —	$ —	$ —	$62,516
California	16,018	17,171	19,901	28,466	30,853
Washington, D.C.	—	—	—	21,409	23,732
Alaska	—	—	—	22,295	23,512
Maryland	14,690	13,640	15,624	17,788	20,408
Virginia	11,915	11,567	12,652	15,754	19,535
Connecticut	12,694	14,839	16,175	20,547	19,497
Illinois	10,641	11,917	14,302	16,484	19,219
N. Jersey	15,809	14,236	13,983	16,083	17,898
Oregon	7,507	8,985	11,458	14,205	16,243
Ohio	12,533	12,859	14,471	16,015	15,858
Pennsylvania	8,441	11,278	11,910	14,462	15,754
Louisiana	7,968	8,537	10,560	13,107	15,328
Vermont	—	—	11,183	13,010	15,163
Massachusetts	—	—	12,721	14,028	15,045
Rhode Island	—	—	—	13,320	14,908
Washington	6,971	8,222	9,494	12,014	14,848
Minnesota	6,917	7,716	10,631	12,757	14,662
Wisconsin	9,327	10,607	12,581	14,286	14,620
Colorado	8,288	9,493	10,952	12,613	14,580
New York	10,048	11,357	12,853	12,360	13,989
Utah	6,990	8,288	11,025	13,412	13,899
Michigan	10,102	10,063	10,713	12,986	13,687
Nevada	7,305	8,334	10,420	11,594	13,382
N. Hampshire	9,124	10,199	12,024	13,068	13,135
Florida	10,196	10,442	11,059	12,049	12,735
Kansas	8,362	10,387	10,922	11,801	12,223
Missouri	8,365	9,354	9,707	10,427	12,079
Montana	—	—	10,717	12,160	11,924
Texas	6,832	7,593	8,537	9,686	11,822
Iowa	7,131	7,385	9,891	10,589	11,659
Idaho	6,344	7,579	9,735	10,868	11,469
Delaware	11,193	12,075	11,394	10,097	11,370
W. Virginia	7,195	8,204	10,478	10,665	11,058
N. Mexico	7,912	7,413	9,184	9,460	11,011
Oklahoma	7,312	7,919	9,816	10,641	10,785
Indiana	7,634	8,109	8,915	10,303	10,665
Georgia	8,610	8,688	9,160	9,838	10,476
Kentucky	9,766	9,031	8,807	9,742	10,353
Nebraska	6,315	6,606	7,601	8,725	10,158
Mississippi	—	4,750	9,295	9,174	9,402
Alabama	7,129	7,935	8,875	9,549	9,300
N. Dakota	—	—	—	7,821	9,200
Tennessee	8,368	8,439	8,091	9,217	9,165
N. Carolina	7,842	7,789	8,231	9,358	9,069
S. Carolina	—	7,907	8,175	8,702	8,865
S. Dakota	5,917	7,163	7,684	8,526	8,500
Arkansas	—	12,833	12,375	—	8,411
Maine	5,261	5,251	6,111	7,026	7,849
Wyoming	—	—	—	—	—
Arizona	—	—	—	—	—
U.S. Total	8,947	9,856	10,841	12,291	13,539

Average Cost of Finished Residential Lot Per Square Foot 1976-1980

State	1976	1977	1978	1979	1980
Alabama	$0.48	$0.47	$0.48	$0.55	$0.55
Alaska	—	—	2.27	2.27	3.00
Arizona	0.27	0.25	0.91	1.15	1.28
Arkansas	0.46	1.13	0.75	0.71	0.85
California	1.57	1.78	2.07	2.96	3.68
Colorado	0.95	1.09	1.25	1.44	1.70
Connecticut	0.44	0.45	0.49	0.63	0.64
Delaware	0.40	0.42	0.77	0.45	0.45
Wash. D.C.	—	—	—	9.43	11.39
Florida	0.95	0.96	1.02	1.13	1.18
Georgia	0.45	0.47	0.47	0.52	0.57
Hawaii	—	—	—	—	10.38
Idaho	0.50	0.67	0.89	1.07	1.16
Illinois	1.09	1.11	1.42	1.57	1.82
Indiana	0.50	0.52	0.58	0.69	0.74
Iowa	0.75	0.69	0.90	0.97	1.00
Kansas	0.75	0.93	0.96	1.08	1.14
Kentucky	0.87	0.79	0.70	0.78	0.89
Louisiana	0.61	0.65	0.95	1.21	1.34
Maine	0.16	0.12	0.14	0.17	0.19
Maryland	1.07	0.95	0.96	1.16	1.48
Massachusetts	0.35	0.40	0.49	0.48	0.49
Michigan	0.72	0.65	0.73	0.95	0.96
Minnesota	0.48	0.51	0.71	0.87	0.99
Mississippi	0.41	0.47	0.63	0.70	0.74
Missouri	0.79	0.83	0.85	0.89	1.01
Montana	0.76	0.84	0.74	1.06	1.04
Nebraska	0.69	0.71	0.83	0.96	1.13
Nevada	0.55	0.89	1.03	0.76	1.82
New Hampshire	0.25	0.25	0.49	0.51	0.60
New Jersey	0.79	0.84	0.87	0.98	1.11
New Mexico	0.72	0.86	0.96	1.00	1.13
New York	0.73	0.86	0.57	0.70	0.79
N. Carolina	0.34	0.44	0.44	0.48	0.47
N. Dakota	0.42	0.45	0.48	0.53	0.86
Ohio	0.65	0.84	0.95	1.14	1.18
Oklahoma	0.59	0.63	0.80	0.92	1.00
Oregon	0.77	1.02	1.28	1.56	1.75
Pennsylvania	0.46	0.59	0.61	0.73	0.78
Rhode Island	—	0.32	0.36	0.40	0.42
S. Carolina	0.38	0.71	0.63	0.65	0.62
S. Dakota	0.63	0.66	0.53	0.49	0.63
Tennessee	0.62	0.63	0.49	0.59	0.79
Texas	0.69	0.81	0.91	0.96	1.18
Utah	0.87	0.94	1.18	1.39	1.45
Vermont	0.40	0.41	0.55	0.44	0.70
Virginia	0.87	0.80	0.97	1.19	1.42
Washington	0.62	0.70	0.89	1.01	1.25
W. Virginia	0.50	0.55	0.64	0.73	0.67
Wisconsin	0.57	0.62	0.78	0.88	0.92
Wyoming		1.00	NA	NA	1.80
U.S. Total	0.77	0.80	0.87	0.95	1.05

Source: Homer Hoyt Institute 1981.

EXHIBIT C

Land Price Index

Yr	Month	National	North-East	North Central	South	West
1979-	1	114.6	104.7	119.5	109.2	119.3
	2	116.3	104.6	121.4	111.8	120.8
	3	116.6	105.4	122.5	112.5	122.1
	4	117.9	104.2	123.9	113.8	123.7
	5	119.2	104.8	123.8	114.6	124.9
	6	120.3	105.7	125.3	115.8	125.5
	7	121.3	104.1	126.1	118.6	127.2
	8	123.9	104.6	127.4	122.3	129.2
	9	125.4	106.8	127.7	125.4	130.3
	10	126.2	107.0	128.9	124.0	130.2
	11	126.9	107.4	130.9	126.3	130.9
	12	128.5	107.0	133.5	127.8	132.1
1980-	1	130.9	106.9	134.2	130.4	134.5
	2	130.7	107.6	135.6	130.0	137.5
	3	133.2	107.5	138.0	131.9	138.8
	4	134.7	105.8	138.0	133.6	140.6
	5	137.7	106.8	139.8	138.7	145.0
	6	139.2	106.0	142.3	139.2	146.2
	7	141.7	107.9	143.5	142.1	148.9
	8	142.7	108.6	144.8	142.4	151.2
	9	144.5	106.8	144.7	144.2	152.9
	10	144.4	106.0	145.2	145.4	153.8
	11	144.9	110.1	147.3	144.4	155.1
	12	144.6	110.7	147.9	144.3	154.9
1981-	1	145.7	113.0	145.7	146.1	156.8
	2	145.6	115.9	145.1	147.7	155.2
	3	145.3	113.3	142.0	146.4	154.2

FOOTNOTE: Data for previous years and by region is available upon request.

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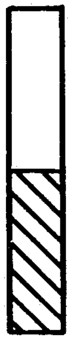
Cost Per Square Foot of Residential Land (in dollars)

Source	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Home Owners Warranty Corp.	n/a	n/a	n/a	n/a	n/a	0.78	0.77	0.80	0.87	0.95	1.05
Bureau of the Census (C-25)	n/a	n/a	n/a	n/a	0.50	0.50	0.76	0.76	0.85	1.04	1.19
FHA 203(b) (New Homes)	0.92	1.04	1.32	1.24	1.34	1.15	1.07	1.07	1.38	1.63	2.07
FHA 203(b) (Existing Homes)	0.66	0.64	0.70	0.75	0.74	0.91	0.92	0.92	1.16	1.25	1.71
FHA 245 (New Homes)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.65	1.99
FHA 245 (Existing Homes)	n/a	n/a	447.	497.	536.	712.	724.	744.	1,024.	1,050.	1,180.
Farm (Rural Residential)*	n/a	n/a	316.	622.	448.	1,110.	751.	948.	624.	1,598.	1,215.
Farm (All Other Residential Uses)*	244.	358.	266.	292.	340.	438.	528.	654.	591.	618.	779.

*Cost per acre; n/a—Not available

Source: Homer Hoyt Institute 1981.

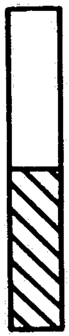
Legend



Total Pond-
Suitable Land

Undeveloped Pond-
Suitable Land

Pond-Suitable Land



Single Family

Multifamily

Undeveloped Residential
Pond-Suitable Land

AN - Atlantic Northeast

BH - Black Hills

GL - Great Lakes

GC - Gulf Coast

PN - Pacific Northwest

RR - Red River

SL - Salt Lake

SW - South West

TV - Tennessee Valley

Note: Acres on a logarithmic scale.

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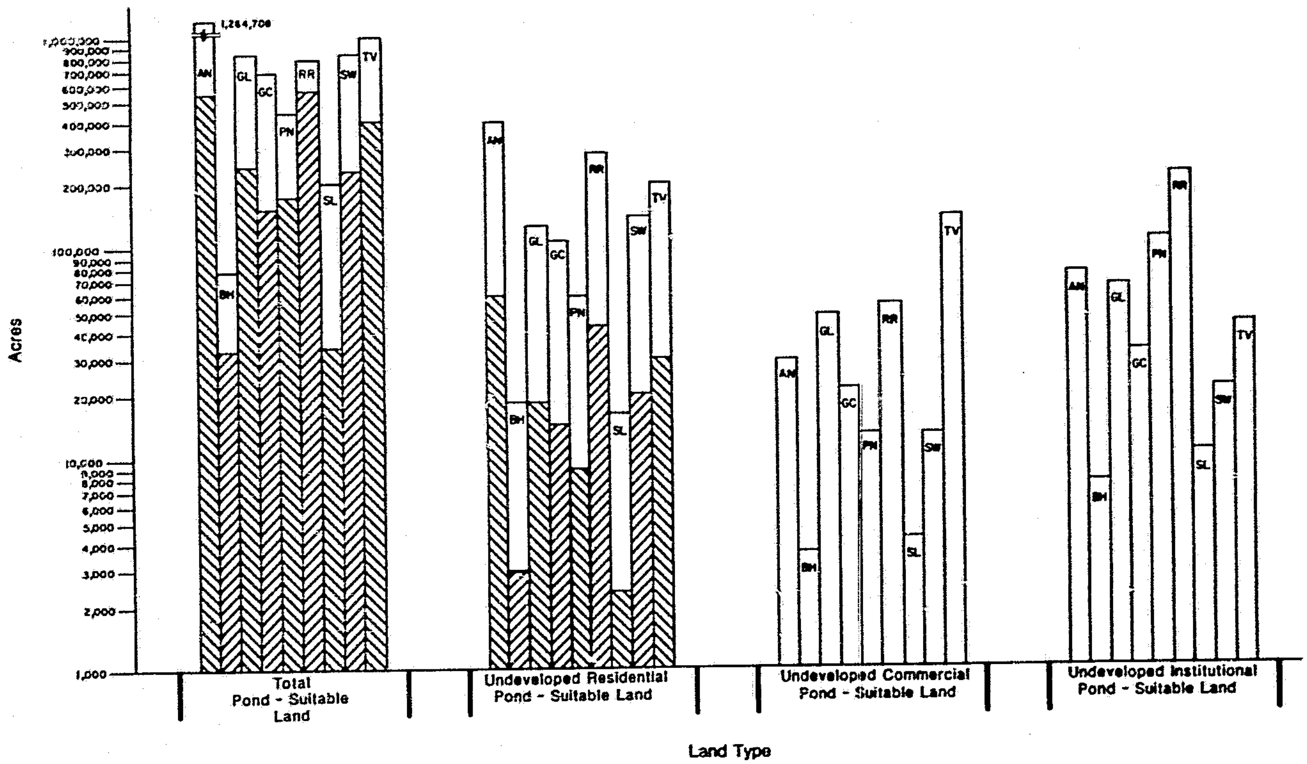


FIGURE E-1

Regional Comparisons of Pond-Suitable Land

Legend

R – Residential

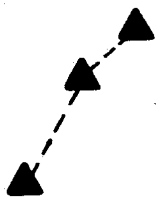
C – Commerical

I – Institutional

▲ – Low-range values

■ – High-range values

– Reveals price ranges within development categories.



– Compares a given price range among the development categories.

Note: Dollar values on a logarithmic scale.

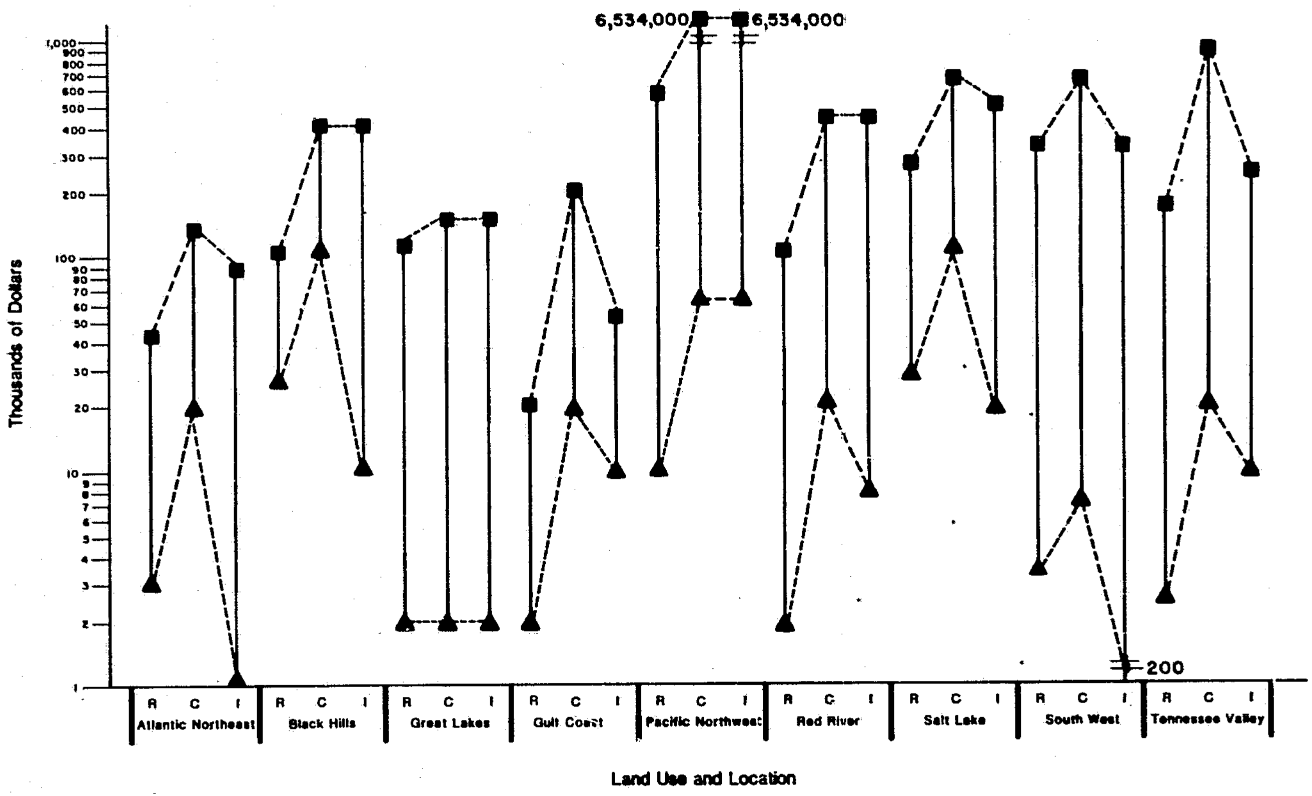


FIGURE E-2

Comparisons of Regional Land Values

APPENDIX F

LAND AVAILABILITY/LAND VALUE ASSESSMENT FOR SAN JUAN, PUERTO RICO

The data required to assess the land-availability/land-value situation in San Juan were not available for the September 1981 draft report. Continued attempts to retrieve representative information for the area were finally successful and have facilitated the development of this section. The decision was made to place this information in the appendices section to alleviate massive changes to Chapter 3. We would like to acknowledge the efforts of Mr. Jose Barreto in gathering the San Juan data.

SAN JUAN, PUERTO RICO

Geography

San Juan is located on the northeastern shore of the island of Puerto Rico. Most of the area is flat. San Juan is the home of the University of Puerto Rico and five other universities. Population and land-area data available for San Juan are sketchy and not reliable.

Land Use/Land Availability

San Juan is an old city with a densely developed, historical central core that is surrounded by a residential suburban ring. Since Puerto Rico is a mountainous island, developable land is at a premium, especially in metropolitan San Juan (approximately one-third of the island). Approximately 33 percent of the island's total land use is classified as forest, water, wetland, or nonproductive.

Table F-1 shows that 68 percent of metropolitan San Juan is developed. Forty-five percent of the developed land is for residential purposes. It is estimated that there are between 8,395 and 37,778 cuerdas (a cuerda is about 1 acre) of pond-suitable land (PSL) associated with residential uses. Commercial land represents 0.6 percent of the developed land. Total commercial PSL is estimated to be 1,373 cuerdas. Institutional land

TABLE F-1

Land Use/Land Availability
San Juan, PR

Development Category	(1) Total Cuerdas[a]	Developed Land (2) Total Developed Cuerdas	(3) Percentage of Pond-Suitable Land	(4) Total Pond-Suitable Land (cuerdas)	Undeveloped Land (5) Total Undeveloped Cuerdas	(6) Percentage of Pond-Suitable Land	(7) Total Pond-Suitable Land (cuerdas)
Residential	41,976	24,409	20-90	4,882-21,968	17,567	20-90	3,513-15,810
Commercial	4,038	2,992	34	1,017	1,046	34	356
Institutional	12,229	11,967	34	4,069	262	34	89
Other (MLU)	21,057	14,559	--	--	6,498	--	--
Total (city)	79,300	53,927	--	9,968-27,054	25,373	--	3,958-16,255

Development Category	Prescribed Density (8) Low: Minimum Lot Size (ft²)	(8) Low: Cuerdas	(9) High: Minimum Lot Size (ft²)	(9) High: Cuerdas	Maximum Units Permitted Under Existing Zoning Code for Developed Land (10) Low (units)[b]	(11) High (units)[c]	Maximum Units Permitted Under Existing Zoning Code for Undeveloped Land (12) Low (units)[d]	(13) High (units)[e]
Residential	86,080	2	4,304	0.1	0.5	40	0.5	40
Commercial[f]	4,304	0.1	4,304	0.1	40	40	40	40
Institutional[g]	4,304	0.1	4,304	0.1	40	40	40	40

Source: Barreto 1981.

[a] A cuerda is equal to 4,000 square meters (43,040 square feet), or about 1 acre.
[b] Data in column 2 divided by data in column 8.
[c] Data in column 2 divided by data in column 9.
[d] Data in column 5 divided by data in column 8.
[e] Data in column 5 divided by data in column 9.
[f] See exhibit D of Appendix A for explanation of data presented in columns 8, 9, 10, 11, 12, and 13.
[g] Assume minimum lot sizes are the same as commercial.

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represents a high 22 percent of the developed land use. Total PSL is estimated to be 4,158 cuerdas for institutional uses.

Table F-2 presents the information on single family/multifamily residential information for San Juan. The ratio of single family land to multifamily land is 19,728 to 22,248 cuerdas. Estimates show that 1,577 million square feet of single family space and 444 million square feet of multifamily space are potentially available in the San Juan region. Of these totals, approximately 37 percent of this space is in the undeveloped part of the city.

Land Values

As indicated in Table F-3, land values in San Juan are very high. These values are for developed land. Due to the high costs of land and financing, very little development, especially residential development, is taking place in San Juan. Industrial development is encouraged, but most development activity seems to be in the Dominican Republic, which has lower overall costs. Statewide land-use regulation is desired by some officials as a way to limit leapfrog development.

Regional Summary

San Juan is the only city being evaluated for this region. Figure F-1 graphically displays the potential availability of PSL in the city. This graph indicates there is a good potential for PSL in the undeveloped residential sector. Undeveloped institutional land is not abundant.

Figure F-2 compares land values in the city of San Juan. Land prices appear to be consistent across the board. Medium land values were not available for commercial or institutional land.

TABLE F-2

Single Family/Multifamily Residential Data
San Juan, PR

Development Category	Developed Land					Undeveloped Land				
	Total Cuerdas[a]	Single Family: Percent of Total	Single Family: Calculated Cuerdas	Multifamily: Percent of Total	Multifamily: Calculated Cuerdas	Total Cuerdas	Single Family: Percent of Total	Single Family: Calculated Cuerdas	Multifamily: Percent of Total	Multifamily: Calculated Cuerdas
Residential	24,409	47	11,472	53	12,937	17,567	47	8,256	53	9,311

Development Category	Existing Zoning for Developed Land							Existing Zoning for Undeveloped Land						
	Unit Breakdown: Percentage		Average Number of Units[d]	Average Square Feet per Unit		Total Square Feet		Unit Breakdown: Percentage		Average Number of Units[e]	Average Square Feet per Unit		Total Square Feet	
	SF[b]	MF[c]		SF	MF	SF	MF	SF	MF		SF	MF	SF	MF
Residential	47	53	488,180	4,304	1,076	987,530,000	278,400,000	47	53	291,340	400	100	589,350,000	166,150,000

[a] A cuerda is equal to 4,000 square meters (43,040 square feet), or about 1 acre.
[b] Single family.
[c] Multifamily.
[d] Obtained by averaging the data in columns 10 and 11 of the residential category in Table F-1.
[e] Obtained by averaging the data in columns 12 and 13 of the residential category in Table F-1.

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TABLE F-3

Land Values
San Juan, PR

Development Category	Range	Average Cost per Cuerda[a]
Residential	Low	$ 80,000
	Medium	120,000
	High	240,000
Commercial	Low	120,000
	Medium	NA[b]
	High	240,000
Institutional	Low	120,000
	Medium	NA
	High	240,000

Source: Barreto 1981.

[a]A cuerda is equal to 4,000 square meters (43,040 square feet), or about 1 acre.

[b]Not available.

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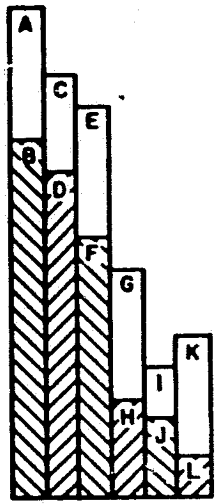
Legend



A - Total city acreage

B - Total city pond-suitable land

C - Total city developed acreage

D - Total city developed pond-suitable land

E - Total city undeveloped acreage

F - Total city undeveloped pond-suitable land

G - Total undeveloped residential acreage

H - Total undeveloped residential pond-suitable land

I - Total undeveloped commercial acreage

J - Total undeveloped commercial pond-suitable land

K - Total undeveloped institutional acreage

L - Total undeveloped institutional pond-suitable land

- Estimated pond-suitable acreage is below the scale of the graph (<100)

- Estimated undeveloped and pond-suitable acreage is below the scale of the graph (<100)

Note: Acreage estimates are on a logarithmic scale.

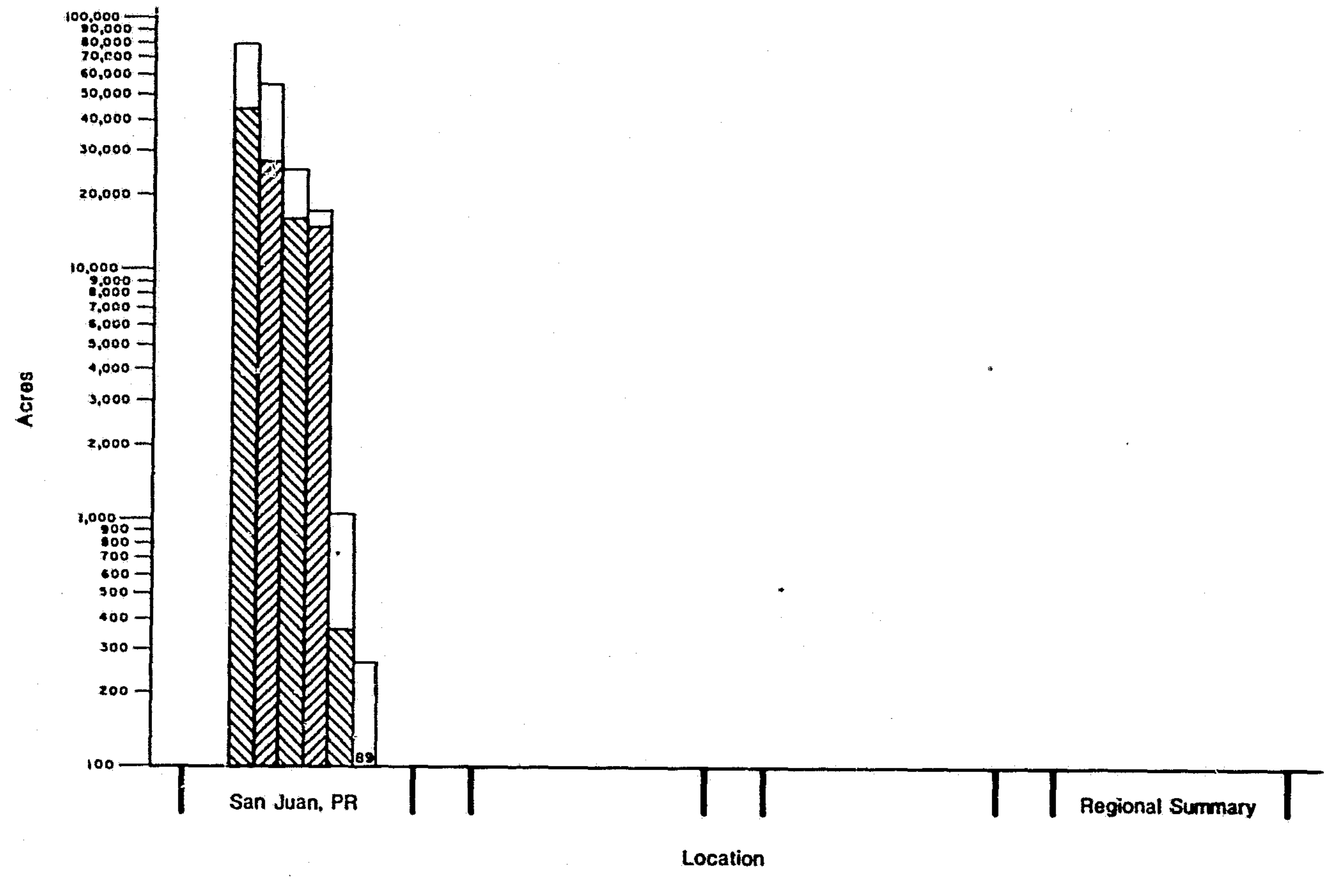


FIGURE F-1

Pond-Suitable Land Comparisons, Puerto Rico Region

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R Residential

C Commercial

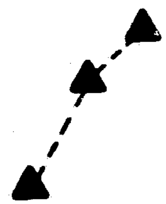
I Institutional

▲ Low-range values

● Medium-range values

■ High-range values

Reveals price ranges
within development categories.



Compares a given price range
among the development categories.

Note: Dollar values on a logarithmic
scale.

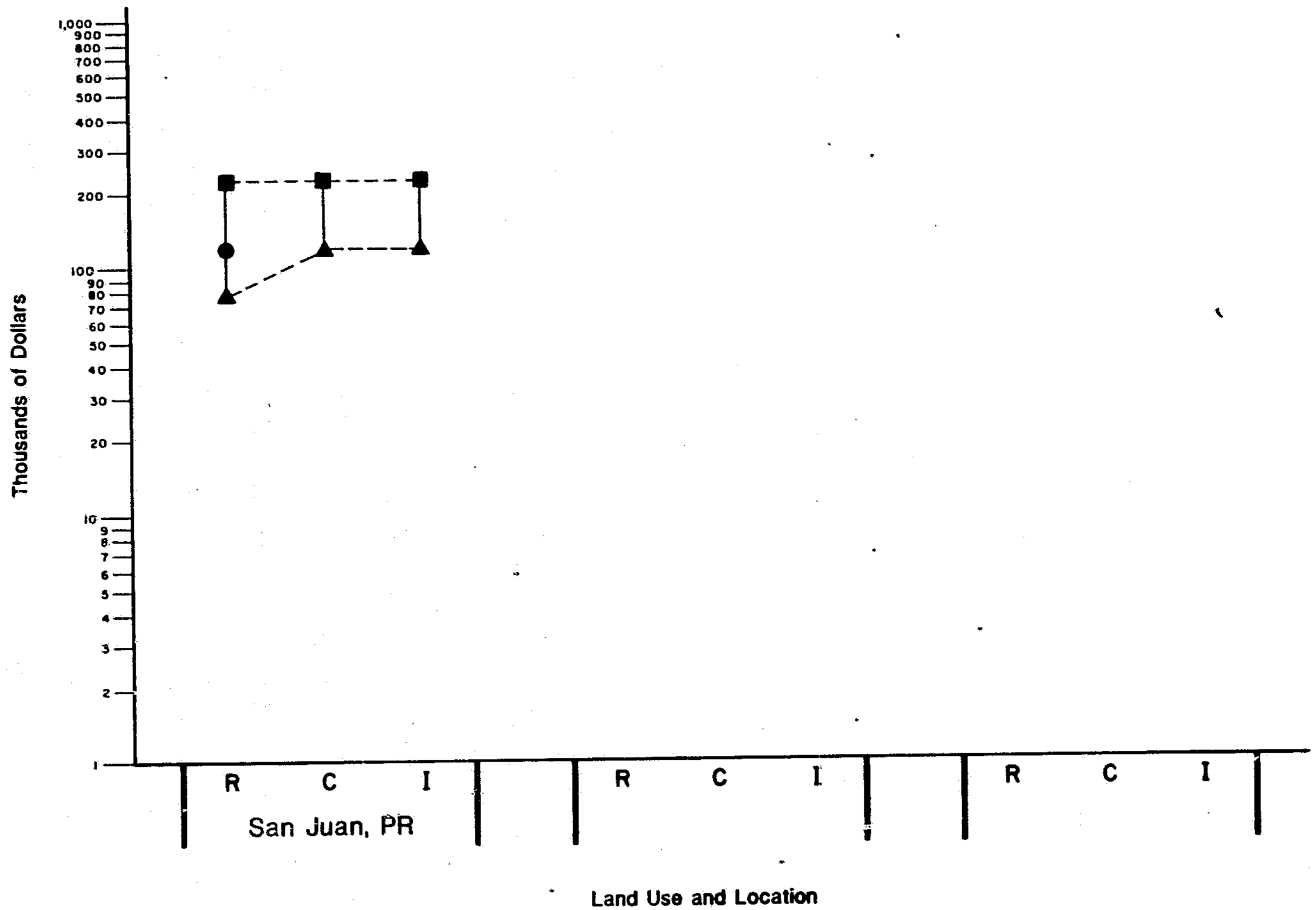


FIGURE F-2

Land-Value Comparisons, Puerto Rico Region